

# **Concrete Batching System**

by

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**CW/CBS Rev.5**

## 1. **General Description.**

- a) The **Compu-Weigh** Concrete Batching System was designed as a conversion from a Manual Plant to an Automatic Plant, but keeping the facility to manually operate the Plant.

By installing load cells into the existing mechanical system and connecting solid state relays across the manual push buttons and switches, the manual system is kept as a back-up.

- b) The **Compu-Weigh** System is capable of controlling the entire Plant, including the additive dose meters, elevating conveyors, water sprays and horn, etc.
- c) Our System incorporates “off the shelf” Industry Standard Computers, Interface Cards and Solid State Relays.

**Compu-Weigh** manufactured items include the A/D boards ,Relay Output Boards and Pulse Counters.

The powder coated enclosure houses all the electronics and has a terminal strip or Multi-Core plug for quick connect / disconnect.

- d) The software was purpose written by **Compu-Weigh** with all weighing and equipment control written in Assembly Language for speed.

## 2. General Description of Hardware

- a) A 486 or higher compatible motherboard with a Compact Flash Disk, 64Mb Ram, VGA Colour Monitor and 101 Keyboard.

I/O boards plugged into this computer are utilized for all interfacing to the “outside world”. This includes:

- Aggregate Supply Bins
- Cement Supply Bins
- Aggregate Weigh Hoppers
- Cement Weigh Hoppers
- Manu Additive Meters
- Horn
- Water Sprays
- Discharge Gates to Load the Truck
- Conveyor Belts.

- b) The I/O Boards switch Din Rail Opto relays of 240 volt AC capacity to control the various equipment.

The solid state relays merely close a contact in parallel to push buttons or switches. This same principle applies with the Manu Meters, except in the case of where a Manu Meter has control of two pumps. In that case, an Auto/Manual switch is added to the Manu Meter to preserve the ability to operate manually.

## **2. General Description of Hardware (cont)**

- c) Two Epson LQ570+ Printers are interfaced to the computer, with one printing Batch records and reports and the second printing Truck Delivery Dockets.
- d) A True On-Line UPS is optional to guarantee perfectly clean power and will back-up computer operation for about 15 minutes. This is mandatory for generator plants.
- e) Load cells are added to the mechanical structure of both the Cement Weigh Hopper and the Aggregate Weigh Hopper, and are usually supplied and installed by others.
- f) Two Gedge Indicators are installed in the face of the enclosure and at the flick of a switch, manual operation is available.
- g) A 150mm high 6 digit remote display is supplied with the left most digits indicating the required Material (i.e. 20 for 20mm or CS for Coarse Sand), and the remaining 4 digits display a decreasing weight.

### **3. General Description of Software**

- a) The Software is divided into three (3) programs.
  - 1. The Menu System has four levels of Password Protection to prevent unauthorized use of the Batching, Reporting and Editing Programs.
  - 2. The Batching Program handles all the I/O control responsible for the Batching of Concrete and the reporting of that Batch to the Printer and a Dated Reporting File.
  - 3. The Editing Program is responsible for the editing of the set-up parameters for Program 2, and all other parameter and formulae files.
  
- b) All the Batches that are possible to be batched have their ingredients specified in a file by that batch name (i.e. 123ABCD). This file contains the quantities of ingredients per cubic metre, which will be used to calculate the target quantities.

### **3. General Description of Software (cont).**

Simply pressing a Function Key and typing in the Batch No. followed by the cubic metres is all that is required to start the Batch. The only point at which the operator's intervention is required is when the water is started and permission is requested to load the truck. Here the computer sounds the horn to advise the driver to increase the Drum r.p.m. and when he has visually confirmed that a truck is in place and ready, then entering the truck number will start a controlled dump pattern of the batched mix.

From here the computer completely controls the discharge pattern, the last 10% of water and additives, prints the completed batch, and sounds the horn twice.

#### **4. Details of Batching Operation.**

- a) When the computer is powered up, the Menu Program is automatically displayed. Selecting “Batching” will start the Batching Program.

When the information for Batches is available, the operator can enter upto 20 batches into a queue and batch in that order, or jump to any batch in the queue in any order.

By pressing Function Key F2, the operator is prompted to enter the Batch No. and cubic metres. If the details in the batch file are complete, then by pressing F5 and confirming the quantities by entering ...Y...., the batch is automatically started.

However, as appears to be the common case, the additive quantities vary from customer to customer. This means the operator has to Edit the target quantities by pressing F3. This will prompt him to enter the queue number to edit or the current queue number by simply pressing Enter.

This display now displays all the quantities per cubic metres, and prompts the operator for new target values. This is entered as normally done manually, i.e. per cubic metre, per 100kg of cement or dose rate. The order in which these items are edited have been programmed for the most frequent edits to come first.

#### **4. Details of Batching Operation (cont)**

For example, Water, Additives, Coarse and Fine Aggregates etc. When the items to be edited have been completed, the operator can escape out of the edit routine.

By pressing F5, the display changes to the RUN DISPLAY, which includes Total Targets for all ingredients for that size load. By entering .....Y.... to accept those totals, the Batch is started by weighing up in the order determined by the filling pattern. Colored bars show the progress towards Target Weight.

If the operator can see there is a truck in place, and the Drum is rotating (not stopped), then the operator can start the water by pressing F6 during the weighing up of the batch. This will fill a pre-determined % of the target water into the truck.

As the ingredients are weighing up, the colour VGA display shows a grey bar graph on a black background, with a percentage graticule.

From this the operator can see the % of a particular material completed and the rate at which it is filling. When, for example, the 20mm is complete, the 20mm bar graph stays at 100% and a new bar appears for the 10mm, which is now starting to fill.

#### **4. Details of Batching Operation (cont)**

During the filling of the Aggregates, the Cement is also filling and a yellow bar shows it progressing towards 100%. If two Cements are required for this load, then on completion of the first cement , a second bar will show the next cement filling.

If the water has been started as described before, then the bars indicating the liquids will be updated each time an Aggregate is completed.

By assigning a step number to each additive in a file, the software can decide at which point of time a particular additive has to be started. For example, water reducer can be filled during the 90% water filling. Other filling times are: with the discharge of cement, after the discharge of all ingredients but before the last 10% of water, with the last 10% of water, after the last 10% of water etc. In all, 5 different filling positions can be selected.

When all the aggregates have been filled according to the decided pattern, the cement will now accurately dither to target and the second cement will be started if required.

#### **4. Details of Batching Operation (cont)**

Now the operator can either use a manual push button to alert the driver, or a Function Key to do the same. Once the drum is at loading speed, then by pressing F7 the operator is prompted for a truck number and docket number ( if that option has been selected). Entering the truck number will start the aggregate discharging by firstly 10%, after which the cement discharge is started. Then both the cement and the aggregate discharge are regulated to allow the cement to discharge evenly with the aggregates but leaving 10% of aggregate to fill after the cement is completed.

Immediately the discharge is complete, the water is re-started to fill the last 10% and any additives that require filling in that part of the cycle. On completion of this, the horn is sounded twice and a report is printed, thereby completing the batch.

#### **4. Description of Batching Operation (cont)**

##### **b) Special Operations:**

Various purchaser's of concrete specify a water/cement ratio or an aggregate to cement ratio or both. The operator determines the moisture content of each material by weighing the wet weight and dried out weight for a sample on a laboratory balance. The resultant moisture % is entered in the Editing Program and modifies a dated moisture file which is used by the Batching Program.

As the water/cement ratio is dependent on the water content of all the ingredients, the operator enters the moisture % each day and during the day if there is a change.

If, when starting a batch, the option water/cement ratio is selected, then the water/cement ratio in the file (which can be edited), will be adhered to by calculating the water in the actual kilos of aggregates and the water in actual litres of additive.

This water quantity will then be used in the calculation of actual litres of water to be added by the computer and the maximum that can be added at the slump stand.

#### **4. Description of Batching Operation (cont)**

The report printed on that batch shows the water/cement ratio with the other details of the batch.

#### **c) Software Safeguards**

Various safeguards exist that can come into play during a batching operation.

If loading of the truck is attempted when the first % of the water is not complete or the water has not been started, then the operator is prevented from dumping the load until the water is complete. If, however, the target value of water is zero, then a warning is issued prior to loading the truck, advising the operator that water quantity is zero, does he really want to discharge this load?

Similarly, if a flow error occurs with any of the liquids, then the whole process is halted until the problem is overcome and F12 is pressed to continue the cycle. This can be an error was detected by the computer before the Manu meter. However, if the Manu meter stops the pump then the computer will still create a flow error as the flow has stopped.

#### **4. Description of Batching Operation (cont)**

If material is left in the aggregate or cement weigh hopper and this material is more than the programmed tolerance, then the operator is given the option of including this material in the next load, zeroing the bins to ignore this extra weight or discharging the excess prior to starting the batch. This can happen in particular with the cement weigh hopper where 20 or 30kg of cement can hang up in the hopper. Vibrators are also activated during the discharge to dislodge any material hung up.

If, through a typing mistake, a quantity of material is entered that is beyond the pre-set upper limit of that material, then the batch will not be started and the operator will be made aware that the target quantity is too large and if it is really required, then this load should be split into two loads.

Keyboard input is checked as much as practical for incorrect characters and values whenever the operator enters data.

When discharging the cement and aggregate, gate dithering is employed to shake loose any material that may be hung up. When the bin is almost empty and close to the tolerance, then by closing the discharge gate and re-opening it, has the effect of shaking loose any remnants.

## **5. Details of Available Functions**

### **General Function Description:**

All functions of the Batching and Reporting Operation are accessed through the 12 Function Keys on top of the keyboard. To increase the functions beyond 12, each function key has its alternative function by pressing ALT + Function Key.

The display is structured in such a way that a brief description of each function is visible on the bottom 20mm of the screen. Immediately above there is a 15mm command line where all the requests for input are made. This means that the operator does not have to scan across the screen to determine what to do next, it is always visible in the same location.

When the program is ready for a new command, then a line appears, i.e.

**PRESS FUNCTION KEY FOR DESIRED TASK.**

If, during this time the space bar is pressed, then the descriptions for the alternative functions replaces the function key descriptions but in a different colour.

## **5. Details of Available Functions (cont)**

The top 10mm of the display shows on the left, the current queue number, then the batch number assigned to that queue number and then the cubic metres. On the right, the current time and date are displayed.

This leaves some 80% of the display available for the editing functions, the run display, display of bin configurations etc.

Function Key F6 is the water start function, and this section of the function key description bar changes colour when the water has been started by pressing F6, or if the water is started automatically for the last 10%.

## 6. Options

- a) The number of Manu Meters controlled can be increased or re-configured in such a way that one Manu Meter can control any number of pumps, simply by using re-directing solid state relays to re-direct the 240V pump signal from the Manu Meter and re-directing the pulse input from a different pulse meter. This still utilizes the safeguards provided by the Manu Meters but reduces the number of Manu Meters required.
- b) The number of weighing hoppers can be increased, however, as the cement is being monitored at the same time as the aggregates, monitoring more than two weighing operations at the same time can slow other operations
- c) As the **Compu-Weigh** system only requires about 20mB of hard disk space and the most readily available CFC disk is 128 Mega-Byte or larger, there is plenty of space to install support programs as long as these are only attempted when no Batching is required. The Menu allows the addition of these choices.