DEWETRON

TAPE SENSOR

TECHNICAL REFERENCE MANUAL

WELCOME TO THE WORLD OF DEWETRON!

Congratulations on your new device! It will supply you with accurate, complete and reproducible measurement results for your decision making.
Look forward to the easy handling and the flexible and modular use of your DEWETRON product and draw upon more than 30 years of DEWETRON expertise in measurement engineering.

ISO9001

EN ISO 14001

THE MEASURABLE DIFFERENCE.

About the content of this document

The information contained in this document is subject to change without notice.

1 Introduction and Basics

Most of the time a rpm measurement is needed at rotating machines . The reasons could be very different. Sometimes it is only an additional information, to all the other measurement channels, and sometimes particular analysis , like Order tracking, Balancing, averaged Orbit require rpm and angle information.

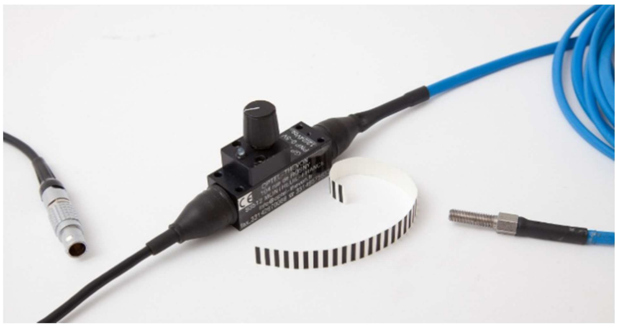
So we need to install a rpm sensor. For sure there are several sensors on the market.
So we could use an encoder, the DEWETRON RIE sensor, or other reflecting probes that deliver a signal which is related to engine speed. All this sensors could be used.
But sometimes this takes a lot of effort to mount such sensors.
Imagine an Encoder, or even the RIE sensor, this will take a while to install, and sometimes it is simply not possible to mount , because of space limitations. Imagine cars engine on
Drive belt side, space is very limited in that area.

So to find a reliable and easy to install sensor is not that easy.

For sure not all sensors can fulfil the requirements needed, for specific applications.

For example a Tacho probe with one pulse could not be used to do a rotational vibration analyse.

2 TAPE Sensor

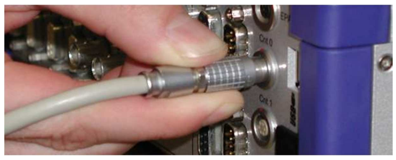


The tape sensor is a speed and angle sensor which uses a black and white tape, which is glued on the rotating part. The reflection is converted from an analyse electronic into a TTL signal.

To also reach areas where space is limited, analyse electronic and sensor part are separated from each other.

The senor itself terminates with a M6 screw, where light is transmitted and received via a fibre optic cable. This is connected to the analyse electronic.

A sensitivity pot is used to set the appropriate trigger level. A light is indicating the trigger at the analyse electronic.

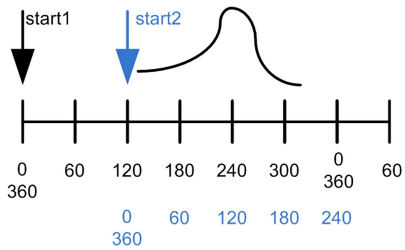


The sensor is connected directly to a DEWETRON LEMO counter input, where also the supply voltage for the sensor is provided. So no additional power supply will be needed.

3 Setup and measurement

3.1 Install Linear black and white tape

First the black and white tape has to be glued around the rotating part.
At the end where it comes together it will not fit exactly to the black and white raster.
So if we would simply do a rpm measurement out of that, we would get a rpm drop or spike, once per revolution. Imagine it would perfectly fit, we would have no “ZERO” pulse per revolution which indicates a defined start position. So every time we start a measurement, the angle would be different.

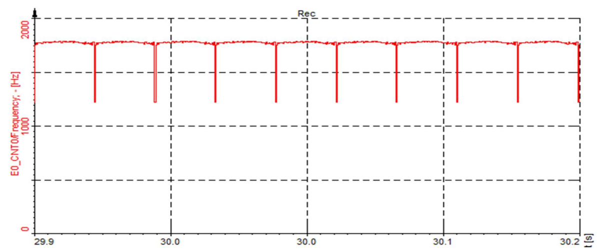


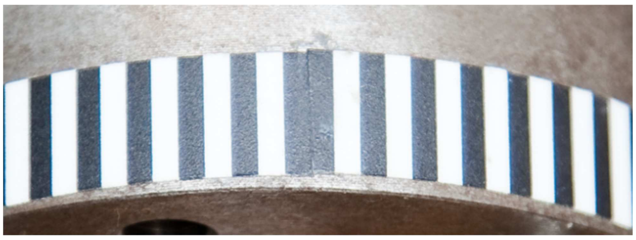
On the right picture a sensor with 6 pulses per revolutions demonstrates what would happen.
At first start, acceleration peak(black curve) appears at 240deg. At the next start it appears at 120deg.

But this indication, black and white tape does not fit exactly to the raster at the end, which creates an rpm drop, could even be helpfully. We could use that as ZERO pulse(like on an Encoder), so angle will start all the time at this position. So every time a measurement is started, the angle information related to shaft will be the same.

For this to be possible the software has to detect this, and use this as “ZERO”. Also the rpm peak or drop at this position hast to be removed and replaced by the average of the pulses before and after that gap.

On the right we can see how the frequency looks like if the last pulse does not fit , in this case the frequency is dropping almost 30%. Here we had luck that the drop and therefore the gap is seen so nice. So that could be already used to detect the ZERO pulse. So angle will start always at that Position.



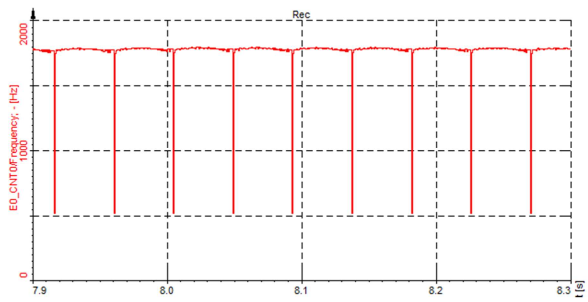


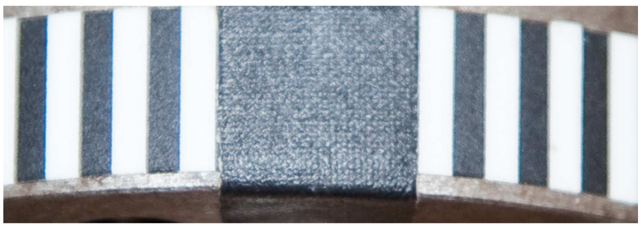
3.2 Wide of the GAP

It could also happen, that the gap fits almost perfectly to the raster of the black and white at the end. So the frequency drop or spike could be so small, that it is hardly deviating from the other frequency.

For the software to clearly see this drop out or peak, the length of the gap must be >3 pulses.

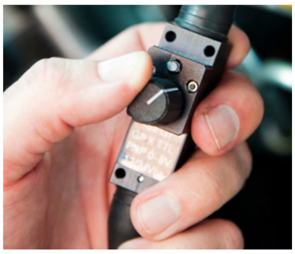
So the frequency will drop for almost 70%, and the software algorithm will have no problem to detect the gap reliably.



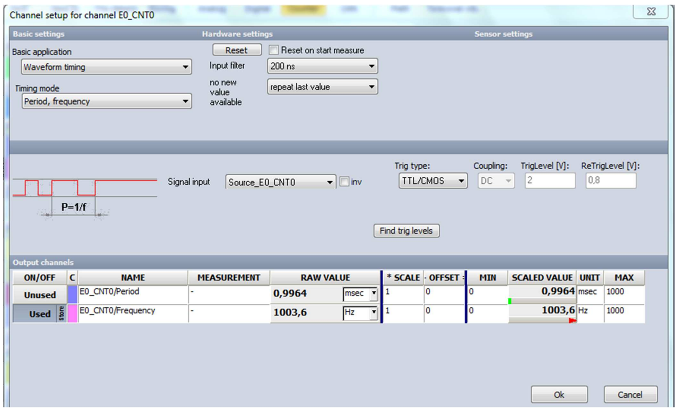


3.3 Adjust TRIGGER LEVEL of sensor.

The sensor should be placed about 2 to 5mm above the tape. After that the trigger level has to be adjusted, so that it delivers reliable pulses.

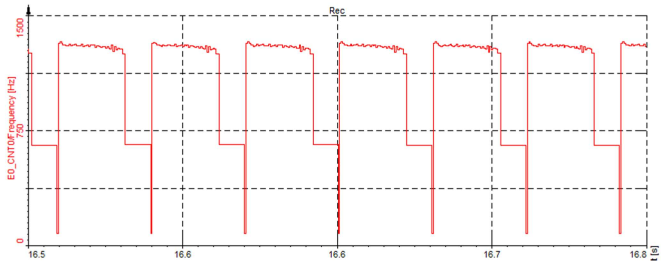


To adjust the trigger level and also check if gap is detected in the right way, a period measurement should be done first.
Please be sure that “repeat last value” is set in counter mode.



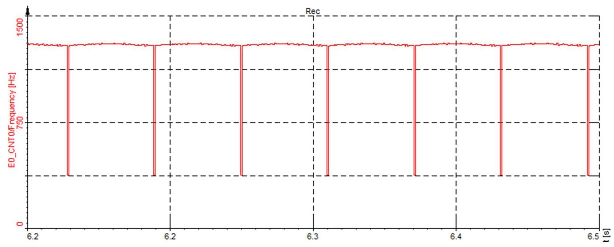
So in counter setup “Waveform timing” and “period, frequency” measurement should be selected.

After that run the machine and observe the frequency in a recorder.



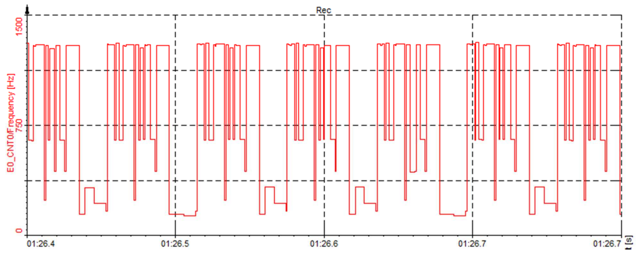
Turn the knop to the left end , and slowly start turning to the right (clockwise). First there will be no output, sensor is not triggering.

After further adjustment, output will start.
1st picture



After further adjustment it will get better and better, till we could see the gap nicely. If we go further it will get again worse.

The right levels is exactly in between.



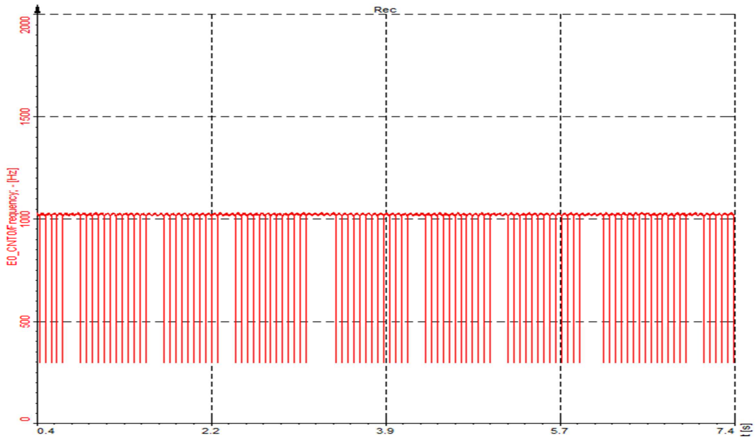
In case you could not find the GAP check next section 3.4 select the right sampling rate.

3.4 Which sampling rate is needed?

Above, we have seen now how to mount and how to adjust the sensor. Which sampling rate is now needed, for this sensor.

Now we would says this is counter, so it does not really matter which sampling rate we use, counter can handle up to few MHz, and result is read out.
This is true.

But here we have a special case. We have to detect the frequency drop, so that gap is seen, and software can calculate start and stop of the angle(0 to 360deg.)



So in case the sampling rate is lower than input frequency of TACHO probe the gap could be missed.

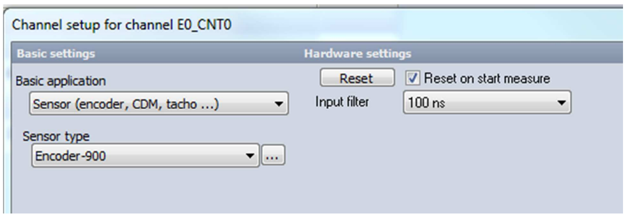
Lets assume we have about 64 pulses/rev the machine is running with 1000rpm/60= 16rps = 16Hz.

16Hz * 64p/rev= 1024Hz input frequency. In the example on the right the sampling rate was set to 1kHz, so we could see that the gap was not recognized at every revolution.

In this case the sampling rate must be at least 2 times higher.
1024Hz *2 is about 2kHz, because speed of the machine could go up we also have to consider that.
We should set it at least to 10kHz.

INFO: Sampling rate > Maximum input frequency * 10 .

3.5 Sensor Type = Tape sensor

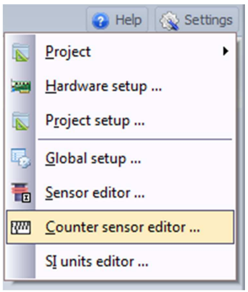


If we do an rpm measurement, or any sensor measurement, Sensor Mode has to be chosen in the counter setup of DeweSoft.

If this is chosen the sensor is selected from a Counter sensor data base where the type of sensor and the settings are stored. In the example an encoder with 900p. was selected.

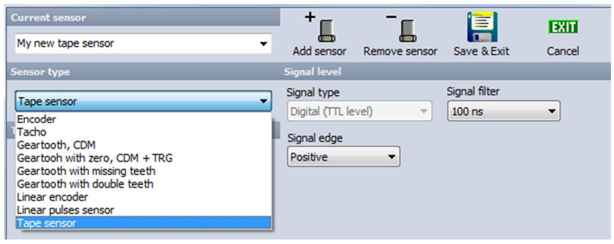
This prepared or created sensors must be added first in the counter sensor editor.

In our case we must add our new Tape sensor.



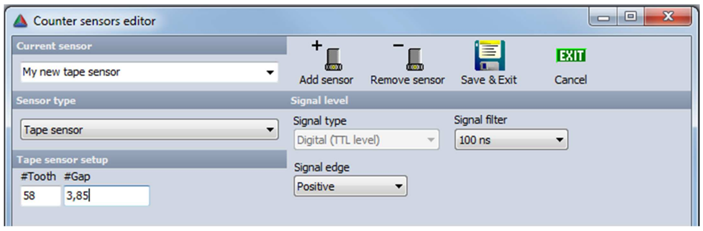
So we have to go to → Settings
→ Counter sensor editor

and create this sensor, that it will be available in the counter setup.



Inside the editor we → ADD sensor and rename it to "<u>My new tape sensor</u>"
for sure any name could be chosen as long as you remember it.

For sensor Type we choose now the → <u>Tape sensor</u>.

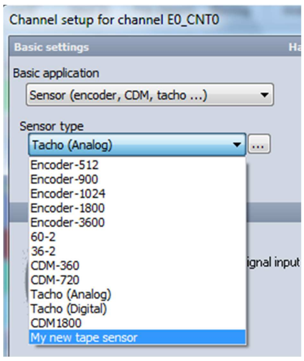


After tape sensor is chosen we could already see the pulses for tooth and gap. At the moment we could roughly enter a number there. Later we will see how that is set up. Also set the filter at least to 100ns and the signal edge to positive. This is only a pre setting. So if sensor is added to counter setup it will set filter and edge according to the settings made in the counter sensor editor.

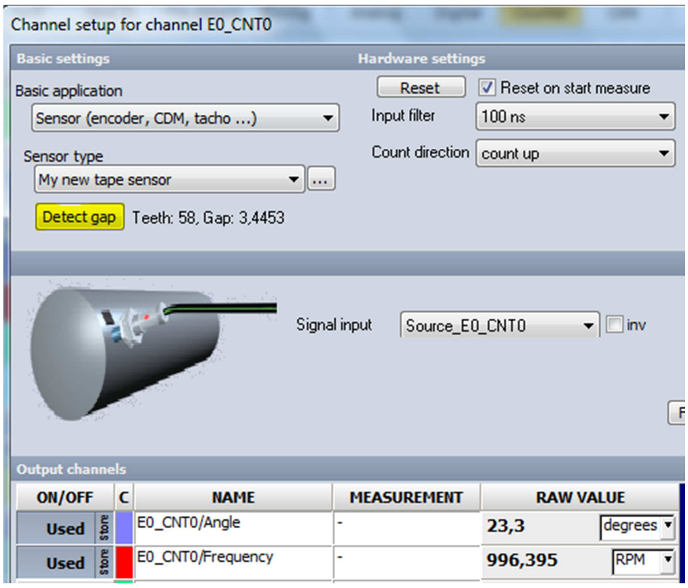
After that we SAVE & EXIT the counter sensor editor.

MY NEW TAPE SENSOR is now added to the counter sensor data base.

Now our tape sensor is created, and can be selected from the drop down menu.



As mentioned above we have to set how many pulses we get per revolution and how many pulses the gap is reflecting.
That's why I mentioned in the counter sensor editor we could enter some rough number into that fields . Now how to enter the right number? Count and measure manually?
NO!
After adding this sensor, there is a function available called DETECT GAP.



This function will automatically measure the pulses per revolution and also detect the exact gap length.

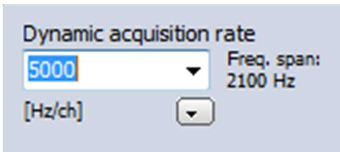
For the gap length calculation the rpm should be as stable as possible. So try to operate the machine in a stable area, so that rotational vibration (rpm deviation) is as small as possible.

The algorithm will average the speed of the machine a few samples before and after the gap, so the average speed around the gap is extracted, and out of that we could calculate the missing pulses.

INFO: Please be aware that we are in setup, so DEWESoft is running with the setup sampling rate, and if that is not high enough, like described in 3.4 gap and teeth detection will not work.

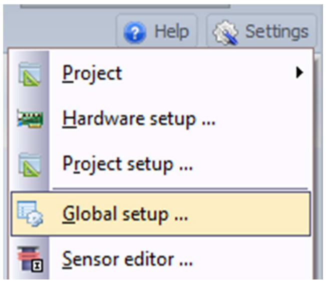
3.5.1 Change Setup sampling rate

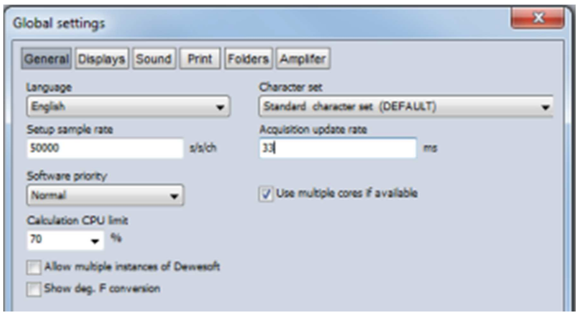
INFO: The setup sampling rate which is actually set could be seen like this. Create a new Setup or Start DeweSoft, the sampling rate shown now in the Dynamic acquisition rate, before a setup is loaded, is the setup sampling rate.



To change the setup sampling rate:

➔ Global Setup
➔ Setup sampling rate

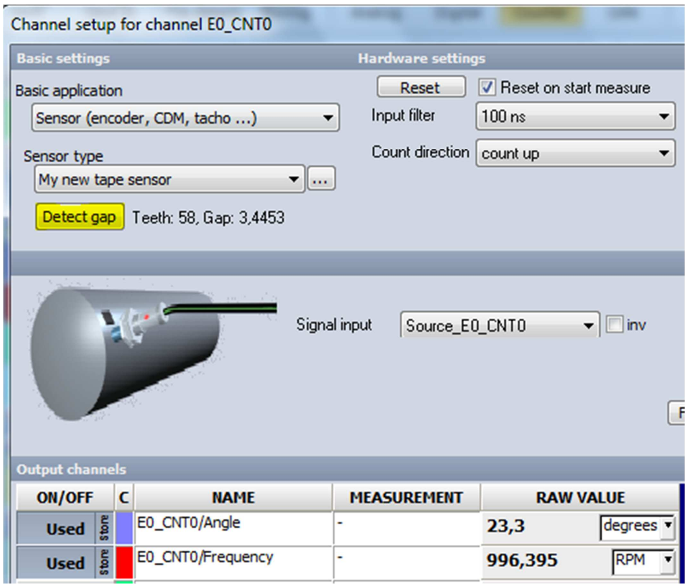


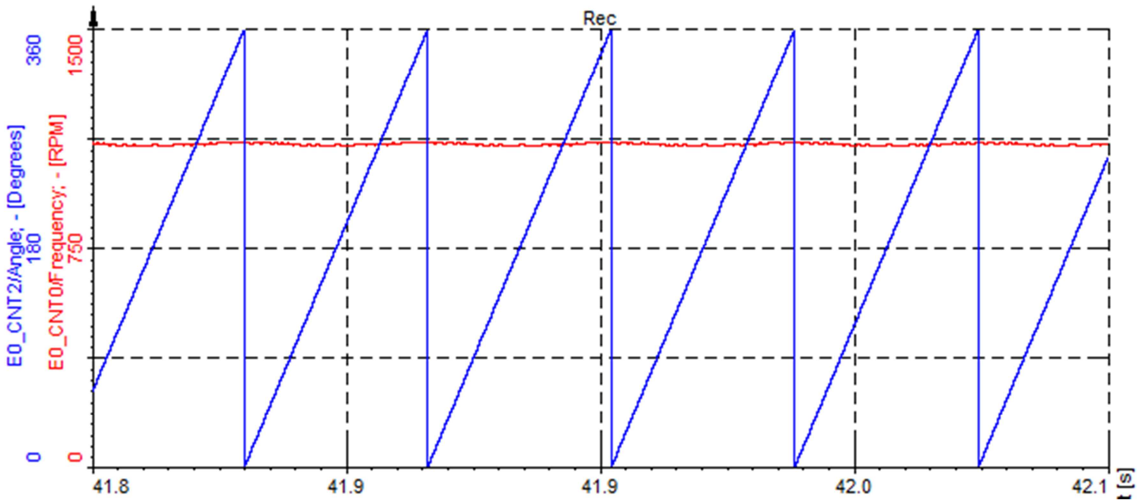


Set sampling rate according to the need.

3.6 Result

The Tape senor will now provide a rpm or frequency channel and a angle signal which will run from 0 to 360deg. Start of the angle signal is the first pulse at the end of the gap.



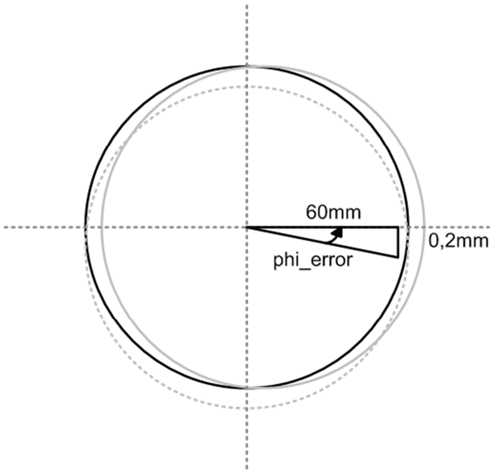


4 Limitations and errors

The sensor is perfectly suited for angle and rpm measurements.
But we should also be aware about the limitations and errors which could be made.
This should only give an example, to get a feeling. For most applications we don't have to consider this. But there are applications where this should be known.

Shaft is not in centre:

Angular error:



If the shaft has a diameter of 120mm and it's out of centre 0,2mm the angle error would be phi= arctan 0,2mm/ 60mm = +-0,2deg.
So the angle will deviate during one revolution +- 0,2deg.

RPM Deviation:

Also the rpm will change because of uncentre of the shaft. The velocity is changing because disc will increase and decrease the speed related to sensor, depending on uncentre.

120,5/120= +-0,4% so at 1000rpm = +-4rpm.

5 Specification

Supply voltage:	9 – 30VDC
Supply current:	120mA
Max input frequency:	100kHz
Output:	TTL
RISE TIME:	200ns
FALL TIME:	<1,5us
Temperature range:	-10° to 50° C non condensing
Temperature fibre sensor:	-40° to +100℃
Temperature B&W tape:	-10° to +60℃
Weight:	150g
Working area of probe:	2-5mm
Trigger level adjustable:	Potentiometer ¾ Turn
TRG deviation:	@ 60pulses/rev 2mm tape < +-1.5% deviation from average speed around current pos.
Probe diameter:	M6 x 20mm
Tape B&W:	2mm black , 2mm white 1cm wide 1meter included

Applications :

- Angle based view
- Order tracking
- Field balancing
- Rotational – Torsional vibration
- General RPM measurement