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EMBEDDED BASED SYSTEM FOR TESTING TENSILE STRENGTH OF FOUNDRY SAND

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ABSTRACT
Sand is the principal moulding material in the foundry as it is using for all types of castings. This paper an idea of testing tensile strength of sand which is using for castings in foundries with the help of load cell. This system defines the sand whether it is good or bad for castings. We cannot check tensile strength of each grain of sand so; we form brick of that sand and then check tensile strength of that sand brick. Sand brick is placed in between load cell and DC motor. DC motor continuously applies force on that brick till it breaks and at other side simultaneously load cell converts that force into electrical signal and analog –to-digital converter converts that into digital and it displays on LED. Force at which point brick breaks motor automatically stops that is the maximum tensile strength of that sand.

KEYWORDS*:* Load Cell, Sand Brick, Tensile Strength , ARM.

INTRODUCTION
Tensile Strength is an important concept in engineering, Importantly in the field of material science, mechanical engineering and structural engineering. Tensile strength testing is commonly used to determine the maximum stress of a material that can endure while being stretched or pulled before breaking. In foundry special type of sand is used for making mould. It is clean, uniformly sized, high quality silica that is bounded to form moulds for ferrous & non ferrous. In that mould cavity the molten metal enters and sand develops several strength zones. As heat transfer theorem, heat transfers from metal to outward direction through sand. As sand has porous, refractory nature and chemical resistivity. Due to this change in the magnitude of temperature observed in mould have significant effect on sand strength. Throughout the pouring process, sand at the mould metal interface is dramatically heated. The water inside this hot layer is vaporized and migrates between sand grains to cooler region. The thermal expansion of silica sand in the hot zone and the weakness of the wet layer can cause rupture between the two layers that is breaks the mould. So it effects on pattern of metal which we want to make. For that reason initially we want to check tensile strength of each type of sand which will be using for further processing in foundry and select which sand will stand for high temperature in casting that is which is better for further process in foundry.

LITERATURE SURVEY
In paper [1, 2], effects of heat on the behaviour of sodium and calcium betonies in bonding foundry sands were studied.

In paper [3], currently, there are several standard procedures for measuring the performance of the materials regarding the mechanical properties; unfortunately, the only way is employing destructive inspections.

In paper [4], metal industries use which types of foundry sand is mentioned. Sand which is uniform sized, high quality silica sand that is bound to form a mould for casting of ferrous and non-ferrous metal. Finer sand than normal sand is used in metal casting process.

Because of rapid temperature rise of mould/metal interface in casting process modifications the physical properties of moulding sand .The dramatic increase in temperature affects the bonding strength of clays.

In paper [5], methods of applying loads are mentioned. Loads are generally applied either mechanically with screw drives or hydraulically with pressurized oil.

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In paper [6], when the casting is finished and is placed in a more complex system, it will be subject to several forces (loads). Therefore, it is important to recognise how mechanical properties influence iron castings.

In paper [7], Splitting Tensile Strength for Foundry Sand Concrete for foundry sand concrete with addition of fibers. The splitting tensile of concrete with and various percentage (10%, 20% & 30%) of replacement of foundry sand and addition of fibers were determined.

In paper [8], bentonite addition, mulling time and compactability have significant influence on wet tensile strength.

In Paper [9], Load cell is used to measure the weight carried out by the bridge load cell outputs a low voltage analog output which has to be amplified and then fed to ADC.

In Paper [10], A microprocessor's architecture defines the instruction set and programmer's model for any processor that will be based on that architecture. Different processor implementations may be built to comply with the architecture. Each processor may vary in performance and features, and be optimized to target different applications.

The ARM architecture has evolved steadily to respond to the changing needs of ARM's partners, and of the design community in general. At each major revision of the ARM architecture, significant features have been added. Between major architecture revisions, new features have been included as variants on the architectures. The key letters appended to the core names indicate specific architecture enhancements within each implementation.

In Paper [11], presents a detailed description of the application of a formal verification methodology to an ARM processor. The processor, a hybrid between the ARM7 and the Strong ARM processors, uses features such as a 5-stage instruction pipeline, predicated execution, forwarding logic and multi-cycle instructions.

The instruction set of the processor was defined as a set of abstract assertions. An implementation mapping was used to relate the abstract states in these assertions to detailed circuit states in the gate-level implementation of the processor. Symbolic Trajectory Evaluation was used to verify that the circuit fulfillseach abstract assertion under the implementation mapping. The verification was done concurrently with the design implementation of the processor. Our verification did uncover 4 bugs that were reported back to the designer in a timely manner.

In Paper [12], says type of The ARM processor enables a wide range of deeply-embedded, high performance and high reliability products to be implemented with reduced system and development costs. Applications for Cortex-R4 include consumer, mobile, storage, networking and automotive devices. The Cortex-R4 implements the ARMv7R architecture for compatibility throughout the Cortex processor family and also for backward compatibility with the ARM9 and ARM11 series processors.

Cortex-R4 is highly configurable for precise application requirements with synthesis options that include Instruction and Data cache controllers, Tightly-Coupled Memory (TCM) interfaces, memory protection, error correction or parity checking, debug and trace and a Floating-Point Unit (FPU).

PROPOSED SYSTEM

(Figure1) shows the block diagram of proposed system. Test brick which is formed by sand which we want to test is placed between load cell and DC motor. This system is suitable for new foundry sand before casting. We need to make specific shaped brick of testing sand, as cannot check tensile strength of each sand grain/particle. In In this system load cell is used to convert a force into an electrical signal. A load cell consists of four strain gauge in a wheatstone bridge arrangements. A Driver circuit contains ULN2803 relay driver that drives relay. ARM processor is mounted for controlling of whole system. ARM processors are based on a reduced instructions set computer (RISC) architecture. The electrical signal output is in order of a few millivolts and requires amplification by an Instumentation amplifier. Here, INA126 IC is instrumentation amplifier is using for amplifying differential input signal from load cell and gives single ended output to ADC in for converting it to digital form. The output of the transducer can be scaled to calculate the force applied to the transducer. That ADC output gives to LED for displaying output.

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Figure 1

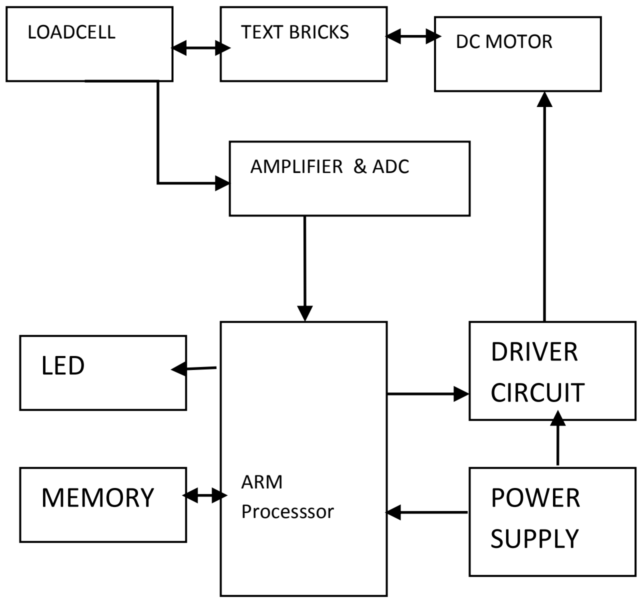

Figure 1: Block diagram of Proposed system for tensile strength of foundry sand

WORKING PRINCIPLE OF DC MOTOR

This system is measure tensile strength , tensile strength testing machine model using load cells. A load cell is a transducer that is used to convert a force in to an electrical signal. Continues force will apply on brick with the help of DC motor. That applying force will directly converted to equivalent differential electrical signal through load cell which is based on a strain-gaged beam with a mounted Wheatstone bridge. That differential electrical signal given to INA126 amplifier, it amplifies signal and gives single ended output to ADC of ARM processor for converting it to digital form. One advantage of a DC Motor is variable speed. Increase the voltage and the speed increases. These continue digital readings stored into memory, perform computation and displays on LED. The point at which test brick breaks is tensile strength of that sand. Tensile strength readings are measured in P.S.I (Pounds per squre inch) Tensile strength readings are shown (Figure 2) in LED Display.

Figure 2

Figure 2 : LED Display

RESULT

The force was applied with the help of DC motor, as continuously applies the force as test brick(Figure 3) with the help of DC Motor resistance of tensile gauges is increases in load cell and compression gauges decrease; so bridge will become unbalance & differential output voltage proportional to applied force will be produced across load cell output. That converted to single ended output with the help of amplifier and given to ADC of ARM it converts into digital form and LED displays that digital output is the tensile strength of sand.

Figure 3

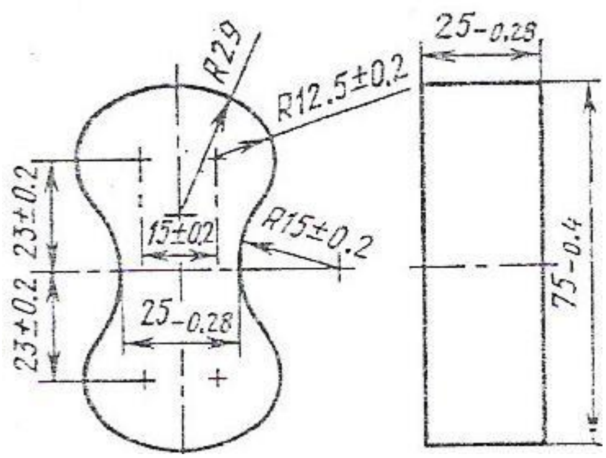

Figure 3: Design shape of the cores for tensile strength test analysis (dimensions are in millimetres)

Tables:

Table 1 . Test brick result for tensile strength

Time Period for brick	Tensile Strength (P.S.I)
1 hour	59
24 hour	70

CONCLUSION

This paper represents accurate testing of tensile strength of foundry sand . In this, ARM processor based testing model test the sand accurately with the help load cell. DC motor is used for applying continuous force on test specimen (Brick). And that applying force converts to equivalent differential electric output signals through load cell which is based on a strain-gauged beam with a mounted Wheatstone bridge. This differential electrical output signals is amplified by instrumentation amplifier INA126 and it gives single ended output to controller. Controlling of DC motor is done by ARM processor. As test specimen brakes motor offs automatically and direct digital reading displays on LED by analog-to-digital converter. This technique does not require experienced employee and processing time is less.

This system is a without computer interface. Tensile strength machine is used to calculate the tensile strength of Green sand, No bake sand, Co2 sand. This system defines the sand whether it is good or bad for castings. This system is suitable in ferrous and non-ferrous metal castings industries.

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