Sospoly Journal of Engineering, Entrepreneurship & Environmental Studies,
Vol. 5, Issue 1, July. 2023, ISSN: 2536-7183
Available Online At http://uaspolysok.edu.ng/sospolyjeee/

FABRICATION OF HYDRAULIC BENCH FOR PRACTICAL DEMONSTRATIONS IN FLUID AND HYDRAULIC MECHANICS LABORATORIES

Abdullahi Abubakar
Umaru Ali Shinkafi Polytechnic Sokoto
abdullahiabubakar979@gmail.com

ABSTRACT

No doubt, local fabrication of hydraulic bench for practical demonstration purpose will enhance growth and development of laboratory technology analysis and reduce foreign cost of importation of the equipment in the country. Hydraulic bench has a wide range of applications, including civil engineering, mechanical engineering, chemical engineering, biomedical engineering, meteorology and biology. The importance of hydraulic bench in fluid/hydraulic laboratories will enable the students to carry out various researches/investigations on the mechanics of fluids (liquids, gases and plasmas) and the forces on them in the laboratory and come out with results. It will also enhance academic learning and promote research in the field of fluid technology both from within and outside the tertiary institution. This research presents fabrication of hydraulic bench for practical demonstrations in fluid and hydraulic mechanics laboratories. The bench will provide an avenue to the departments of civil and mechanical engineering students to cater for practical and final project works. The method applied includes; sourced of information from available literatures, sampling and survey of related materials for fabrication, Parameter design, cutting, bending, connection and construction. The materials used include stainless steel sheet, bolt and nut, arc welding machine, cutting and bending tool, centrifugal pump, control switches, circuit breaker, back nut and nipple, adaptor, union, gate valves, tap, pipes, glues etc. After construction, the device was put to use for first time and its performance was observed, errors and imperfections were identified. Corrections of errors and imperfections were made and later put the device to use for the second time and its performance was certified. The device was finally placed in the fluid/hydraulic laboratory and recommend for practical demonstrations by students.

Keywords: *Fabrication, Hydraulic bench, Practical, Demonstration.*

INTRODUCTION

In civil engineering discipline, laboratory analysis and demonstrations used in hydraulic and fluid mechanics laboratories is an active field of research with many problems that are partly or wholly unsolved. Hydraulics is an engineering science which deals with water, Fluid mechanics deals with the behavior of fluid under the conditions of rest or motion (Rajput, 2000). Hydraulic topics range through some parts of science and most of engineering modules, and cover concepts such as pipe flow, dam design, fluidics and fluid control circuitry, pumps can be performed in hydraulic laboratory to investigate performances, flow characteristics, fluid mechanics and the rest applications and the hydraulic fields. A Hydraulic Bench is a mobile self-contained bench with recirculating water supply (Subhabrata & Gargi, 2020). It was invented by Joseph Bramah of

England and was issued a patent in 1795 (Parker D.T 2013). A centrifugal Pump moves water from the Sump Tank through a hose into a Water Inlet at the top of the bench. The Water Inlet point can be used to attach close-conduit devices (e.g., a Venturi meter), or fitted with a device to allow flow into a small flume for open-channel flow tests (e.g., Weir Plate tests) (*Amazon, 2023).* No doubt, local fabrication of hydraulic bench for practical demonstration purpose will enhance growth and development of laboratory technology analysis and reduce foreign cost of importation of the equipment in the country. Hydraulic bench has a wide range of applications, including civil engineering, mechanical engineering, chemical engineering, biomedical engineering, meteorology and biology. Civil Engineering Department is known to have distinct options on which specialization was based upon which water resources and environmental engineering are made inclusive. Basic Hydraulic Bench is of volumetric type and has been designed to provide continuous and controlled supply of water to conduct various experiments using auxiliary modules in typical fluid mechanics and hydraulics laboratory (NIT Nagaland – 2017-2023). The importance of hydraulic bench in fluid/hydraulic laboratories will enable the students to carry out various researches/investigations on the mechanics of fluids (liquids, gases and plasmas) and the forces on them in the laboratory and come out with results. It will also enhance academic learning and promote research in the field of fluid technology both from within and outside the tertiary institution. However, this research is aimed at fabrication of hydraulic bench for practical demonstrations in fluid and hydraulic mechanics laboratories.

Background

Request was made for hydraulic bench to attach with flow measurement and hydraulic model apparatuses in the hydraulics laboratory to ease for conducting various practical with students. Fluid mechanics is one of the core study areas in engineering being the basis of hydraulics. A full and thorough understanding of fluid power, its generation, control and transmission is a prerequisite to a successful engineering career. The use of hydraulics in industry is widespread. Hydraulics covers subjects as diverse as river and tidal flow, turbines and power generation, stability of vessels, pipe flows and measurement. The P.A. Hilton range of fluid hydraulics products allow students to study, review and compare key study areas as part of this learning area. This unit is the basis for all of the Hilton HB range to be built upon and allows the study of many different fundamental principles within the realms of hydraulics and fluid flow via the current range of optional extras (*P.A Hilton, 2022*). The hydraulic bench is to fulfill a complete fluid mechanics laboratory, incorporating fluid statics, fluid dynamics, open channel flow and rotodynamic machines (*Armfield UK's Edu., 2014*).

METHODOLOGY

Physical survey to identify different types of hydraulic bench was carried out and the best design that was easy to coupled and dismantled during and after practical work was selected. Feasibility study on materials and methods of fabrication work of the bench was also made. The parameter for the hydraulic bench was designed and the metal cutting and connections work commenced.

The materials used include stainless steel sheet, bolt and nut, arc welding machine, cutting and bending tool, centrifugal pump, control switches, circuit breaker, back nut and nipple, adaptor, union, gate valves, tap, pipes, glues etc. Welded and bolted connection was used in steel and plumbing work respectively. After construction, the device was put to use for the first time and its performance was observed so that to be able to identify errors and imperfections (if any) for necessary correction. The device was put to use for the second time and its performances were certified and later filing and painting work was done. Adequate safety measure in construction work was taken at the time of design, cutting, connection & shaping of metal so that damages and faulty work that affect the process of construction may not established.

The following plates describe some of the construction methods/steps carried out during the fabrication work:

Plate1: The welding connection in stainless steel use in the Fabrication Work after the parameter was designed.

Plate2: Part of the hydraulic bench.

Plate3: Section of metal cutting and bending work

Plate4: Metal cutting and bending work cont.

Plate5: Metal bending process cont.

Plate6: Section of the upper Part of the hydraulic bench

Plate7: View of a Welded connected top of the hydraulic bench

Plate8: View of an upper part of the fabricated hydraulic bench connected with welding.

Plate9: 1hp Centrifugal pump that draws water from sump tank and supplies it for performing experiment

Plate10: Half inch ON/OFF Gate Valve used in the hydraulic bench for pumping

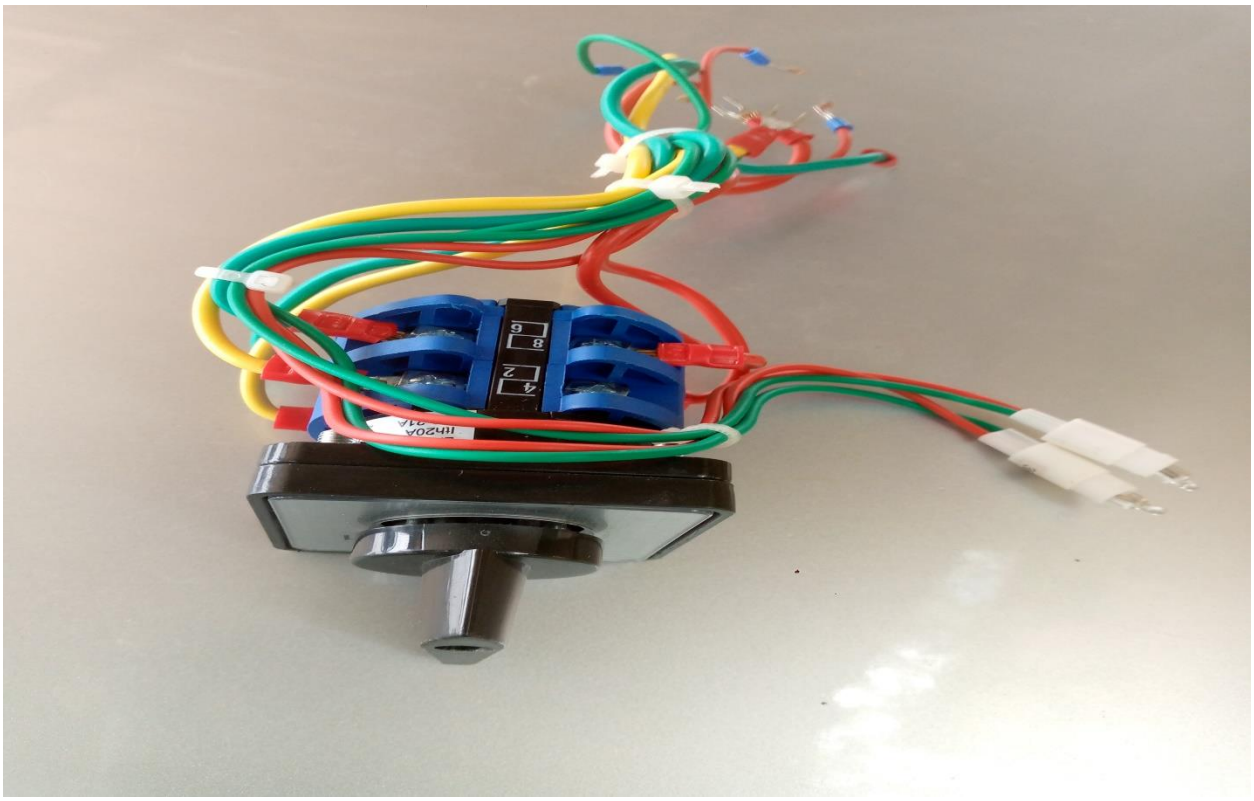

Plate11: Electrical accessory (Control Switch) used in the hydraulic bench

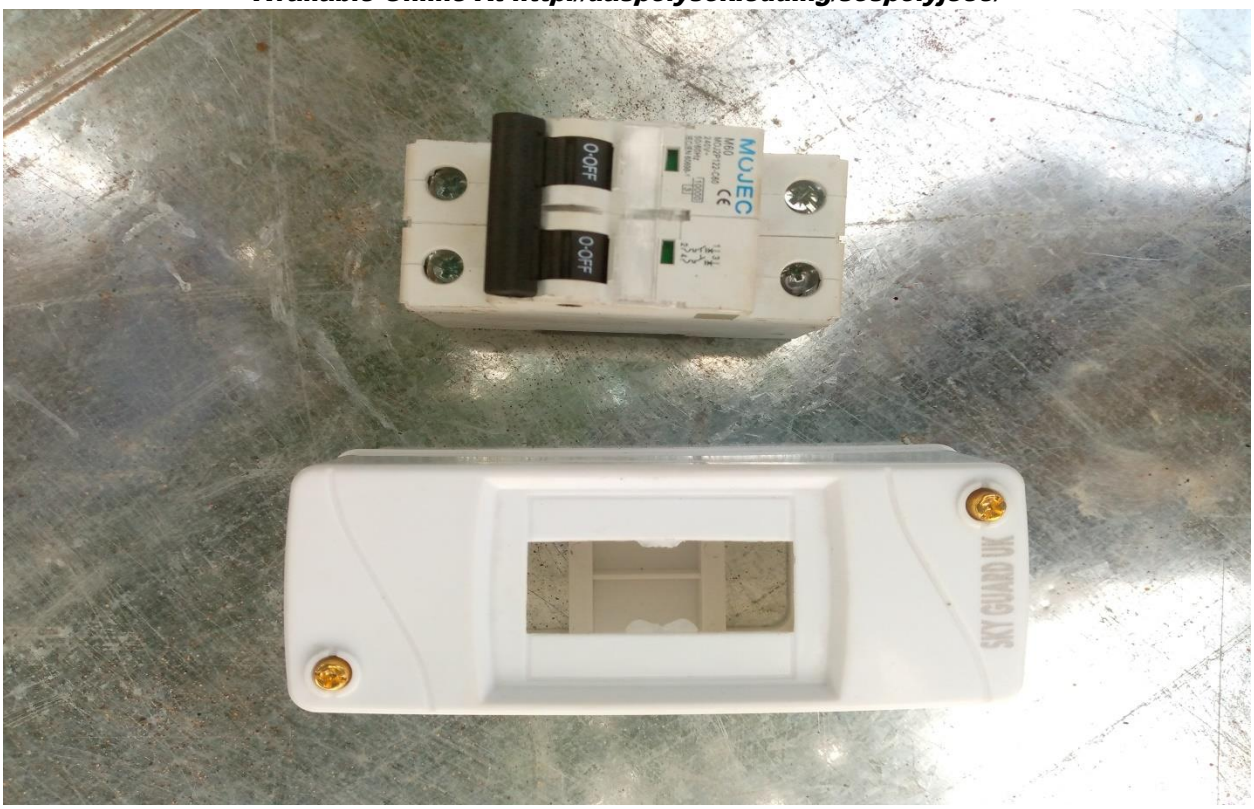

Plate12: Electrical accessory (Single phase breaker) used in the hydraulic bench

Plate13: View of the fabricated Hydraulic bench before filing and painting

Plate14: Vertical view of the hydraulic bench while filing in progress

Plate15: Inner part of the hydraulic bench showing sump tank located at the bottom portion that store water.

Plate16: Hydraulic bench showing point where Single phase breaker is to be fixed.

Plate17: Electric motor (1hp Centrifugal pump) fixed at the bottom of the hydraulic bench for pumping

Plate18: Completed Hydraulic bench (pump) connected with flow measurement apparatus in the Hydraulic Lab.

RESULT

After construction processes, the hydraulic bench fabricated was attached with flow measurement and Osborne-Reynolds's demonstration apparatuses in the fluid/hydraulic laboratory. The bench was working well and Practical demonstration was conducted with perfect results as outcome.

CONCLUSION

On the whole, the fabrication of hydraulic bench for practical demonstrations in fluid and hydraulic mechanics laboratories deemed it necessary to attach with flow measurement and hydraulic model apparatuses in the laboratories to ease for conducting various practical with students. Its significance enhances academic learning and promotes research in the field of fluid technology both from within and outside the tertiary institution. The applications of hydraulic bench range over a huge part of the hydraulics such as the study of flow over a weir, Bernoulli's theorem demonstration, water hammer, flow through orifices, study of flow-meters, centrifugal pump, Osborne-Reynolds's demonstration apparatus, series parallel pumps, Pelton turbine, Francis turbine, Kaplan turbine, propeller turbine and many more. However, in practicing hydraulics with students, some simple fluid regulatory rules and fluid phenomena can provide additional insight into academic science so as to understand the workings of the tool or machine from Hydraulic Bench. The need for further research in the area to measure the true discharge of fluid flow by using the working principle of Hydraulic Bench and to know the factors that might affect the water

discharge and the application or working methods by using Hydraulic Bench are of great concern to most institution of learning.

BENEFITS/RECOMMENDATION

On the completion, there are many benefits derivable. Some of the benefits include:

- Provides an opportunity for staff continuous refreshing on practical training.
- The bench will provide an avenue to the departments of civil and mechanical engineering students to cater for practical and final project works.
- Creation of opportunity for both the civil engineering department and department of other college to offer research services in the area of fluid and hydraulic fields.
- To develop an avenue for consultancy services to other users in the field of practice.
- The device was put in the fluid/hydraulic mechanics laboratory and finally recommended for use by staff and students.
- Further research should be conducted for different type of hydraulic bench to understand its working methods and applications.

REFERENCE

Armfield UK's Education Blog, Engineering Education Technology (2014). International Conference on Fluvial hydraulics, India. https://discoverarmfield.files.wordpress.com.

©2023 Amazon Web Services, Inc. or its or its affiliates. All rights reserved. Retrieved from: amazonaws.com/Courses/FluvialHydraulics/Lecture/2014

National Institute of Technology Nagaland 2017 – 2023, Developed by web Tea, NIT Nagaland https://www.nitnagaland.ac.in

P.A Hilton Ltd. Speak to an expert: Sales @p-a-hilton.co.uk, National: 01794 388 382 ©2022 Retrieved from: https/www.p-a-hilton.co.uk

Parker, Dana T. Building Victory: Aircraft manufacturing in the Los Angeles Area in World War II. p.87, C press, CA, 2013. ISBN: 978-0-9897906-0-4.

Rajput, R.K. (2000). A Textbook of Fluid Mechanics in S.I Units: ("fluid mechanics and hydraulic achiness" Part 1). S. CHAND & Company LTD, (AN ISO 9001: 2000 COMPANY). RAM NAGAR. 110 055.

Subhabrata Ray and Gargi Das, (2020). ebook, Elsevier science, ISBN: 9780128148860, 0128148861. Retrieved from: www.techequipment.com