HYDRAULIC BENCH AND ACCESSORIES

HD 150 -HYDRAULIC BENCH

A base module for experiments in fluid mechanics containing large and small stepped measuring tanks for volumetric measurement of large and small flow rates.

HD 150.01 - PIPE FRICTION FOR LAMINAR/TURBULENT FLOW

Measurement of pressure losses in laminar /turbulent flow

Determining the critical Reynolds's number and pipe friction factor

Comparing the actual pipe friction factor with theoretical friction factor

HD 150.02 - CALIBRATION OF PRESSURE GAUGE

Operation of a bourdon tube Pressure gauge and piston manometer and calibrate gauge with piston manometer.

HD 150.03 - PLATE WEIRS (NOTCHES)

Discharge Measurement in open channel using three different measuring weirs

HD 150 Hydraulic Bench required for experimentation.

HD 150.04 CENTRIFUGA L PUMP

Determining the characteristics of a typical centrifugal pump.

HD 150.05 - HYDROSTATIC PRESSURE IN LIQUIDS

Investigation of fluid pressure on vessel walls.

HD 150.06 - STABILITY OF FLOATING BODIES

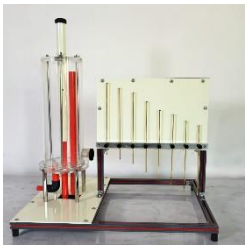
Determination of metacenter and buoyancy using a rectangular hull section

HD 150.07 - BERNOULLI'S PRINCIPLE

Static pressure and total pressure distribution along the venture nozzle

HD 150.08 - MEASUREMENT OF JET FORCES

Demonstration of the principle of linear momentum and impact forces on interchangeable deflectors with different deflection angles.



HD 150.09 - HORIZONTAL FLOW FROM A TANK

Recording the trajectory of the water jet at different outlet velocities.

HD 150.10 - FLUID FRICTION APPARATUS

Influence of flow velocity, Length, diameter and Material on pressure loss.

HD 150.11 – VERTICAL FLOW FROM A TANK

Determination of pressure losses and contraction coefficient for different outlet contour.

HD 150.12 METHOD OF FLOW MEASUREMENT

Comparison of different flow measuring methods and determining the flow coefficients for different flow meters.

HD 150.13 FREE AND FORCED VORTEX APPARATUS

Recognition of surface profiles for free and forced vortex.

HD 150.14 – HYDRAULIC RAM

Formation and effect of water hammer. Pumping of

water using

HD 150.15 - SERIES AND PARALLEL CONFIGURATION OF PUMPS

Determining the characteristics curves and hydraulic power output and comparison of series and parallel operating modes

HD 150.16 - OSBORNE REYNOLD'S EXPERIMENT

Visualization of laminar and turbulent flow

HD 150.17 - OPERATING PRINCIPLES OF PELTON TURBINE

An impulse turbine with adjustable nozzle; determination of characteristics curves and efficiency.

HD 150.18 - OPERATING PRINCIPLES OF FRANCIS TURBINE

A Reaction turbine with adjustable guide vanes; determination of characteristics curves and efficiency.

HD 150.19 - VISULAISATION OF STREAMLINES IN OPEN CHANNEL

Flow around various drag bodies and incident flow of weirs, ink used as contrast medium

HD 150.20 - ENERGY LOSSES IN PIPING ELEMENTS

Pressure losses in various pipe fittings and valves.

HD 150.22 - PITOT STATIC TUBE MODULE

Demonstrate the Pitot static tube operation as measuring instrument and to draw the velocity profiles in a pipe.

HD 150.23 - CAVITATION DEMONSTRATOR

Visualization of the formation of vapor bubbles in a venture nozzle and to find the cavitation number.

HD 150.25 - PIPE NETWORK APPARATUS

Pressure losses at various piping elements and pipe networks;

Parallel and series connection of pipe sections

HD 150.26 CALIBRATION OF ROTAMETER

Demonstration of flow measurement and use of rotameter for calibration.

HD 150.27 FLOATING BODIES FOR HD 150.06

Find the metacentric height and center of gravity for different shaped floating bodies.

CLOSED CIRCUIT AND SELF CONTAINED UNITS

HD 101 BERNOULLI'S THEOREM VERIFICATION APPARATUS

Verify Bernoulli's Theorem experimentally.
Plot the Total energy vs. distance.

HD 102 FLOW THROUGH ORIFICE AND MOUTHPIECE

To determine the co-efficient of discharge of different Orifice and mouthpieces.
To determine the co-efficient of velocity

HD 103 DISCHARGE OVER NOTCHES

To determine the discharge of coefficient (c_d) for different notches.

HD 104 IMPACT OF JET ON VANES

To measure the force developed by a jet of water upon different types of vanes.
Comparison with the forces predicted by the momentum theory.

HD 105 LOSSES DUE TO FRICTION IN PIPELINES

To determine the losses due to fiction in pipes and to determine the friction factor for Darcy Weisback equation.

HD 106 LOSSES DUE TO PIPE FITTINGS, SUDDEN ENLARGEMENT AND CONTRACTION

To determine loss of head in the fittings at various water flow rates and to measure the loss coefficient for the pipe fittings.

HD 111 DISCHARGE THROUGH VENTURIMETER, ORIFICEMETER AND ROTAMETER

To determine the co-efficient of discharge for Venturimetre and orifice meter and to measure discharge through Venturimetre, Orifice meter and Rotameter. To calibrate the Rotameter.

HD 113 REYNOLD'S APPARATUS

To determine the Reynold's number and hence the type of flow either laminar or turbulent.
To study transition zone.

HD 114 PITOT TUBE SET UP

To find the point velocity at the center of a tube for different flow rates of water and calibrate the Pitot tube. To plot velocity profile across the cross section of pipe.

HD 115 CAVITATION APPARATUS

To observe the phenomena of cavitation.

To compare the theoretical and actual pressures at cavitation condition.

HD 122 FREE AND FORCED VORTEX APPARATUS

To plot the surface profiles for forced and free vortices using surface profile coordinates.

HD 123 DARCY'S LAW APPARATUS

To verify Darcy's law.

To find out the coefficient of permeability of a given medium.

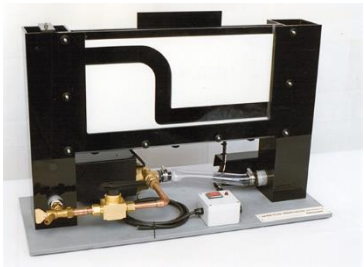
HD 124 STUDY OF PRESSURE MEASUREMENT

To demonstrate the working of different pressure measuring devices.

To measure the pressure and pressure difference by pressure gauge, single column manometer, U Tube manometer & Inclined tube manometer.

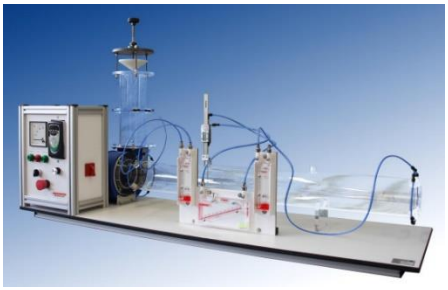
HD 126 HYDRAULIC RAM

To demonstrate the operations and find the efficiency of a hydraulic ram



HD 128 VISUALISATION OF DIFFERENT FLOWS

Streamlines when flowing around different solid drag bodies**.** Streamlines when flowing through different shaped models **and** flow over different weirs



HD 129 PRINCIPLES OF AIR FLOW

Recording the fan characteristics and efficiency and with the available accessories velocity distribution in the pipe and pressure distribution around ac cylinder. Friction losses in pipe, pipe bends and angles.

HD 129.01 PRESSURE DISTRIBUTION ON A CYLINDER

HD 129.02 PRESSURE LOSS IN PIPE ELEMENTS

HD 129.03 HEAT TRANSFER AT A CYLINDER IN TRANSVERSE FLOW

HD 130 AIR FLOW DEMONSTRATION APPARATUS

Calculating flow rate and flow velocity, recording the different velocity profiles in both the free jet and the pipe cross-section.

Representation of the pressure loss in the system characteristic representation of the pressure loss at different pipe elements

HD 130.01 VENTURI TUBE

HD 130.02 MEASUREMENT OF BOUNDARY LAYER

HD 131 FLOW OF COMPRESSIBLE FLUIDS

Pressure losses in pipes and pipe elbows
Flow in convergent/divergent nozzles
Supersonic flow in the de Laval nozzle
Determine the speed of sound in air
Compare calculation methods for incompressible and compressible flow

HD 132 CHARACTERISTICS OF NOZZLE

Determining the critical pressure ratio
Demonstration of the “choking effect”
Determining flow velocity in the narrowest cross-section
Measurement of the reaction or action force of the flowing fluid
Determine nozzle efficiency by thrust

HD 133 NOZZLE PRESSURE DISTRIBUTION APPARATUS

Pressure curve in de Laval nozzles **and** convergent nozzles
Connection between inlet pressure and mass flow rate or exit pressure and mass flow rate
How pressure drop in the nozzle affects the temperature

HD 134 AIR FLOW IN PIPES AND PIPE ELEMENTS

Pressure losses for laminar and turbulent pipe flow
Determination of the friction factor for different pipe materials and diameters (Darcy-Weisbach equation)
Pressure loss in one or several pipe angles
Study of the jet force
Function of an orifice plate flow meter

HD 135 OPEN CHANNEL AND CLOSED CHANNEL FLOW

Open channel

Flow over control structures: broad-crested weir, narrow-crested weir, ogee-crested weir with ski jump spillway, sill, discharge under a gate, hydraulic jump

Closed channel

Pipe flow with constant and variable flow cross-section, measurement of static pressure and total pressure, calculation of the flow velocity

HD 136 WATER HAMMER IN PIPES

Water hammer as a function of flow rate

Water hammer as a function of valve closing time

Display pressure curve, determine reflection time

Calculation of the wave propagation velocity in water

HD 158 PIPE SURGE AND WATER HAMMER APPARATUS

Transient flow conditions in pipe systems by means of experimentation
Demonstrating water hammer in pipes
Determining the sound velocity in water
Understanding how a surge chamber works
Natural frequency in the surge chamber

HD 156 DETERMINATION OF SETTLING VELOCITY

Vertically falling body in liquid using specimens of different sizes and different materials

HD 157 HYDROSTATIC BENCH

Study of buoyancy on a variety of bodies
Study of the density of liquids
Hydrostatic pressure, Pascal's law
Communicating vessels
Determination of the centre of pressure
Study of surface tensions
Demonstration of capillarity

Boyle's law
Study of static and dynamic pressure component in flowing fluid
Familiarization with various methods of pressure measurement

HD164 OPEN CHANNEL SEDIMENT TRANSPORT

Bed-load transport in open channels
Subcritical and supercritical flow
Formation of ripples, dunes and antidunes
How flow velocity affects bed-load transport
Fluvial obstacle mark (siltation/scour formation)

- bridge pier
- sluice gate
- visualisation of the flow
- open-channel flow without sediment transport
- subcritical and supercritical flow
- control structure: sluice gate

- discharge measurement on the sharp-crested weir

HD 166 TRANSIENT DRAINAGE PROCESSES IN RESERVOIRS

Demonstrating transient drainage processes in two rainwater retention basins located one behind the other
Demonstrating transient drainage processes in two storage lakes located one behind the other
Recording oscillations of the water level in a surge chamber after water hammer
Recording and displaying water level fluctuations

HD 167 GROUND WATER FLOW

Determining the groundwater level
Lowering of groundwater level via two wells
Groundwater flow on excavation pits
Groundwater studies under concentric load on the substrate

HD 168 HYDROLOGICAL INVESTIGATION AND RAINFALL SIMULATOR

Investigating transient processes
Effect of rainfall of varying duration on the discharge
Storage capacity of a soil
Investigating steady processes
Seepage flow
Effects of wells on the groundwater level over time
Flow behavior of rivers, obstacles in the river bed, sediment transport in rivers

HD 169 PRESSURE LOSSES IN PIPES

Fundamentals of flow measurement
Fundamentals of pressure measurement

HD 171 CAVITATION IN PUMPS

Cavitation formation
Observation of cavitation effect
Effects of speed, inlet pressure, flow rate and temperature affect cavitation

Determination of the friction factor for different pipe materials and diameters
Resistance coefficients of pipe bends, enlargements and contractions
Pressure losses and opening characteristics of valves and fittings

HD 170 OPEN WIND TUNNEL

Experiments with accessories
Determine drag and lift coefficients for different models
Pressure distribution on bodies immersed in a flow
Boundary layer analysis
Investigation of flutter
Wake measurement
in conjunction with the fog generator
Visualization of streamlines

ACCESSORIES AVAILABLE

HD 170.01 PITOT STATIC TUBE

HD 170.02 BOUNDARY LAYER ANALYSIS WITH PITOT TUBE

HD 170.03 TWO COMPONENT FORCE SENSOR

HD 170.04 THREE COMPONENT FORCE SENSOR

HD 170.05 FOG GENERATOR FOR FLOW VISUALISATION

HD 170.06 SYSTEM FOR DATA ACQUISITION

HD 170.07 ELECTRONIC PRESSURE MEASUREMENT FOR WIND TUNNEL

HD 170.08 ELECTRONIC DISPLACEMENT MEASUREMENT

HD 170.09 DIFFERENTIAL PRESSURE MEASUREMENT

HD 170.10 MODELS FOR DRAG FORCE

HD 170.11 MODELS FOR LIFT FORCE

HD 172 WIND TUNNEL FOR VISULAISATION OF STREAMLINES

Visualisation of streamlines
Flow around or through differently shaped models
Flow separation and turbulence
Stall as a function of the angle of attack

HD 173 AIR DRIVEN IMPULSE TURBINE

Design and function of an impulse turbine
Determination of torque, power and efficiency
Graphical representation of characteristic curves for torque, power and efficiency
Investigation of the effect of nozzle pressure and number of nozzles

HD 174 AIR DRIVEN REACTION TURBINE
Determination of the power output.
Determination of the efficiency.
Preparation of the characteristic curve.
Comparison of experiment and calculation.

HD 176 CHARACTERISTICS VARIABLES OF HYDRO TURBOMACHINES

Centrifugal pump

- Measuring inlet and outlet pressures of the pump
- Determining delivery height
- Determining hydraulic output
- Determining mechanical output
- Recording characteristics at various speeds

Determining the efficiency

With accessories Pelton turbine, Francis turbine or propeller type turbine

Measuring torque and speed

Determining efficiency of the turbine

Recording characteristics

Demonstration of a pumped storage plant

HD 177 EXPERIMENTS WITH RADIAL FAN

Operating behavior and characteristic variables of a radial fan
Recording the fan characteristic (pressure difference as a function of the flow rate)
Effect of the rotor speed on the pressure
Effect of the rotor speed on the flow rate
Effect of different blade shapes on the fan characteristic and efficiency
Determination of hydraulically power output and efficiencies

HD 178 EXPERIMENTS WITH AXIAL FAN

Flow rate vs. pressure
Fan input, output and overall efficiency.
Effect of speed on fan performance.

HD 179 TWO SATGE AXIAL FAN

Determining the fan characteristic
Series configuration or individual operation of axial fans
Determining the energy balance
Determining the radial pressure and velocity distribution on rotor and guide vane system by means of a probe
Effect of the blade position

HD 180 PELTON TURBINE TRAINER

1. Principle of operation of a Pelton turbine
Characteristic at constant head
Relationship between torque and speed
Efficiency dependent on speed
Flow rate dependent on speed
Hydraulic power and mechanical power dependent on speed
2. Evaluation of measuring values and characteristics based on the theory
3. Partial load behavior with needle control in comparison to throttle control.

HD 181 FRANCIS TURBINE TRAINER

Principle of operation of a Francis turbine
Characteristic at constant head
Relationship between torque and speed
Efficiency dependent on speed
Flow rate dependent on speed
Hydraulic power and mechanical power dependent on speed
2. Evaluation of measuring values and characteristics based on the theory
3. Partial load behavior with change in angle of guide vanes in comparison to throttle control.

HD 182 KAPLAN TURBINETRAINER

To study the operation of Kaplan turbine.
To determine the Output Power of Kaplan Turbine.
To determine the turbine efficiency.

HD 184 RECIPROCATING PUMP CHARACTERISTICS

To determine total head, overall efficiency, pump

efficiency and volumetric efficiency of the reciprocating pump.
To plot Graph:
Head vs. Discharge
Pump efficiency vs. Discharge.

HD 185 CHARACTERISTICS OF JET PUMP

To determine total head, pump output, overall efficiency and pump efficiency of the Jet pump.
To plot Graph
Head vs. Discharge
Pump efficiency vs. Discharge
Pump HP vs. Discharge.

HD 186 CHARACTERISTICS OF GEAR PUMP

To determine total head, pump output, overall efficiency and pump efficiency of the Gear pump.
To plot Graph
Head vs. Discharge
Pump efficiency vs. Discharge
Pump HP vs. Discharge.

HD 187 MULTIPUMP TEST RIG

To study the characteristic performance of different type of pump and to study the series parallel operation of pump

To plot graph between different characteristic variables.

Comparison of different delivery characteristics

HD 189 SINGLE STAGE AIR COMPRESSOR

Setup and operating behavior of a compressed air generation system with single-stage piston compressor
Determination of the characteristic curve
Determination of the volumetric efficiency
Determination of the mechanical efficiency

HD 190 DOUBLE STAGE AIR COMPRESSOR

Design and function of a two-stage compressor
Measurement of relevant pressures and temperatures
Determination of the intake volumetric air flow rate
Compression process on a p-V diagram
Determination of the efficiency

HD 191 CHARACTERISTICS OF RADIAL COMPRESSOR

Operating behavior and characteristic variables of a radial compressor

Recording of the compressor curve for both stages
Effect of the rotor speed on the pressure
Effect of the rotor speed on the flow rate
Distribution of stage pressure ratios
Effect of compression on the temperature increase
Determination of hydraulically power output and efficiencies

HD 225 AERODYNAMIC TRAINER

Together with appropriate accessories: experiment from the field of flow around bodies
Velocity measurement of flows with Pitot tube
Boundary layer analysis on a flat plate with flow along the plate
Drag of bodies
Demonstration of the Coanda effect
Visualization of streamlines
Together with appropriate accessories: experiments from the field of steady incompressible flow
Velocity measurement of flows with Pitot tube and Pitot static tube
Free jets
Flow in a pipe elbow
Proof of Bernoulli's principle

ACCESSORIES AVAILABLE FOR AERODYNAMIC TRAINER

HD 225.01 BOUNDARY LAYERS
HD 225.02 DRAG FORCES
HD 225.03 COANDA EFFECT
HD 225.04 VISUALISATION OF STREAMLINES
HD 225.05 BERNOULLI'S PRINCIPLE
HD 225.06 FLOW IN A PIPE BEND
HD 225.07 FREE JET

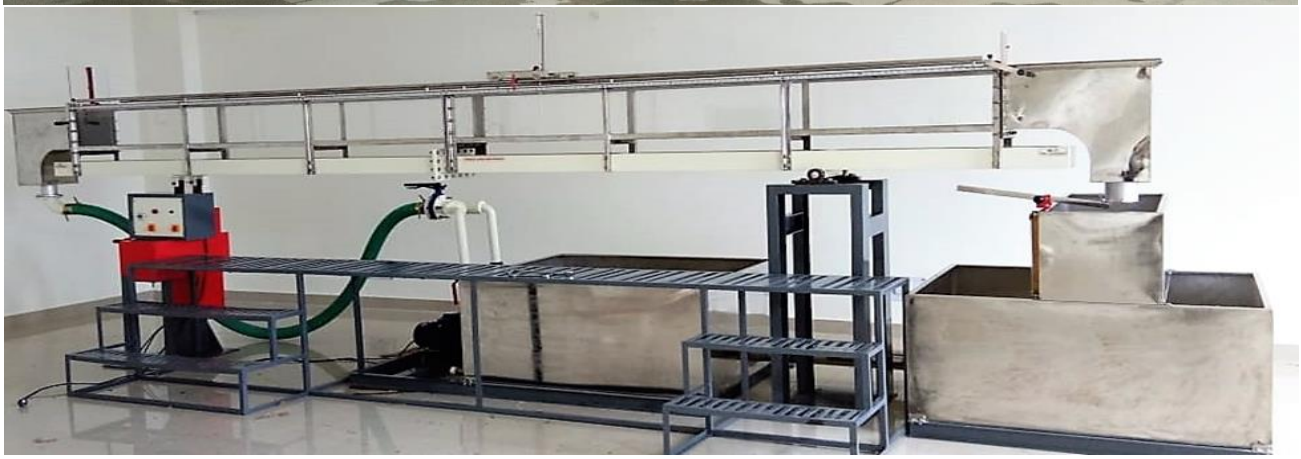
HD 193 FLOW THROUGH FLUIDIZED BED

Fundamentals of the fluidization of bulk layers
Pressure loss dependent on
Flow velocity
Type and particle size of the bulk solid
Determination of the fluidization velocity and comparison with theoretically calculated values (Ergun equation)
Dependency of the height of the fluidized bed on the flow velocity

HD 194 FLOW THROUGH PACKED COLUMNS

To study relationship between velocity of fluid and pressure drop per unit packed length.

EXPERIMENTAL FLUMES AND RELATED ACCESSORIES



HD 127 EXPERIMENTAL FLUME 2.5 M

WIDTH X DEPTH = 80mm x 300 mm

HD 159 EXPERIMENTAL FLUME 5M CAN BE EXTENDED UPTO 12.5 M

WIDTH X DEPTH = 250 X 300 mm

HD 160 EXPERIMENTAL FLUME 5M CAN BE EXTENDED UPTO 12.5 M

WIDTH X DEPTH = 300 X 300 mm

HD 161 EXPERIMENTAL FLUME 5M CAN BE EXTENDED UPTO 12.5 M

WIDTH X DEPTH = 310 X 450 mm

HD 162 EXPERIMENTAL FLUME 10 M CAN BE EXTENDED UPTO 16M

WIDTH X DEPTH = 410 X 500 mm

HD 163 EXPERIMENTAL FLUME 16M CAN BE EXTENDED UPTO 25 M

WIDTH X DEPTH = 600 X 800 mm

ACCESSORIES AVAIALBLE FOR PERFORMING VARIOUS EXPERIMENTS WITH EXPERIMENTAL FLUME

SLUICE GATE

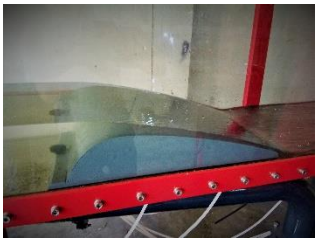
RADIAL GATE

SET OF PLATE WEIRS

BROAD CRESTED WEIR

VENTURI FLUME

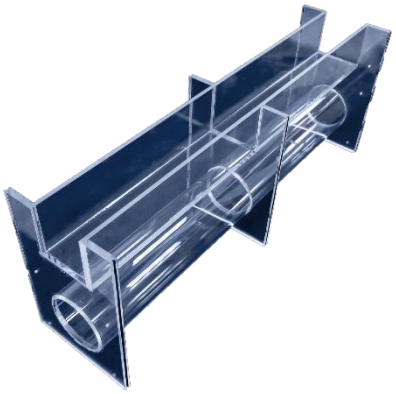
CRUMP WEIR



STREAMLINED HUMP

OGEE WEIR

PARSHALL FLUME



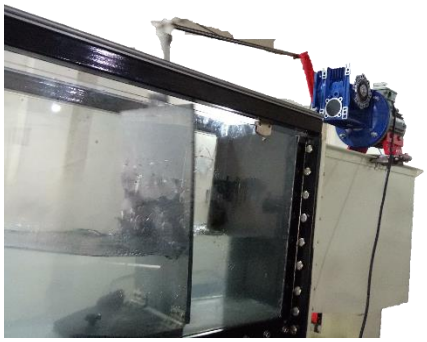
CULVERT

SET OF PIERS

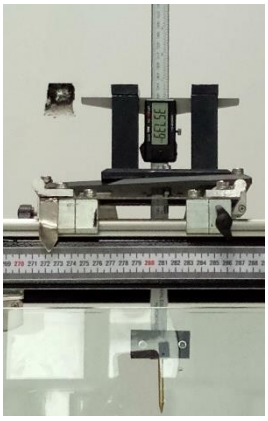
INSTRUMENT CARRIER

SIPHON SPILL WAY

EXTENSION ELEMENTS



WAVE GENERATOR



LEVEL GAUGE WITH VERNIER

HD 200 CUTAWAY MODELS

HD 200.01 STANDARD ORIFICE PLATE

PRINCIPLE OF HEAT TRANSFER

Calculate the thermal conductivity λ of different metals
Calculate the thermal resistance of the sample
Heat transfer with different samples connected in series
Effect of sample length on heat transfer

FHT 102 HEAT CONDUCTION IN FLUID
Determine the thermal resistance of fluids
Determination of thermal conductivities k for different fluids at different temperatures

FHT 104 FREE AND FORCED CONVECTION APPARATUS

Free and forced convection
Calculation of convective heat transfer at different geometries
- Flat plate
- Cylinder
- Tube bundle

Experimental determination of the Nusselt number
Calculation of typical characteristic variables of heat transfer

FHT 101 HEAT CONDUCTION IN METALS

Time dependency until the steady state is reached

Nusselt number
Reynolds number
Investigation of the relationship between flow formation and heat transfer during experiments

FHT 106 HEAT TRANSFER BY RADIATION

Verify Lambert's inverse-square law
Verify Stefan-Boltzmann law
Verify Kirchhoff's law
Study transient behavior
Create power balances
Produce logarithmic diagrams for evaluations

FHT 107 RADIAL AND LINEAR HEAT CONDUCTION

Linear heat conduction (plane wall)
Determination of temperature profiles for different materials
Determination of the temperature profile in case of a disturbance
Determination of the thermal conductivity λ

Radial heat conduction
Determination of the temperature profile
Determination of the thermal conductivity λ

FHT 108 THERMAL CONDUCTIVITY OF BUILDING MATERIAL

Determine the thermal conductivity λ of different materials
Determine the thermal resistance
Thermal conductivity λ for several samples connected in series.

FHT 109 STEADY STATE AND NON STEADY STATE HEAT CONDUCTION

Steady heat conduction
Transient heat conduction
Temperature/time profiles
Calculate thermal conductivity λ of different metals

FHT 110 CONVECTION AND RADIATION

Study the phenomena of heat transfer over a range of pressure and vacuum
Determination of emissivity value of the heater element
Measurement of pressure and temperatures
Verification and calculation of heat loss, emissivity and Stefan-Boltzman constant

FHT 111 THERMAL CONDUCTIVITY OF INSULATING POWDER

Determination of thermal conductivity of three different insulating powder.

FHT 111A THERMAL CONDUCTIVITY OF INSULATING POWDER
Determination of thermal conductivity of insulating powder (asbestos)

FHT 112 EMMISIVITY MEASUREMENT APPARATUS

Determination of the Emissivity of a test plate.
Study the variation of emissivity of test plate with absolute temperature.

HEAT TRANSFER (PHASE TRANSITION)

FHT 201 VAPOUR PRESSURE OF WATER – MARCET BOILER

Recording the vapor pressure curve of water
Presentation of the relationship between pressure and temperature in a closed system
Temperature and pressure measurement

FHT 202 EVAPORATION PROCESS

To concentrate a solution and to evaluate the following at steady state:
Material and Heat Balance.
Economy and the capacity of the evaporator.
Overall heat transfer co-efficient.

FHT 204 DROPWISE AND FILMWISE CONDENSATION APPARATUS

Visual observation of film wise and drop wise condensation as well as nucleate boiling
Determination of heat transfer coefficients in both film wise and drop wise condensation at different operating pressure
Investigation of the relationship between saturation pressure and temperature for water up to 100°C.
Study on the effect of air on the rate of heat transfer in a condenser
Demonstration of Dalton's Law.

FHT 203 BOILING PROCESS

Visualization of different forms of evaporation
Free convection boiling
Nucleate boiling
Film boiling
Heat transfer
Effect of temperature and pressure on the evaporation process

FHT 205 POOL BOILING APPARATUS
To study the pool boiling phenomenon up to critical heat flux point.

FHT 206 SEPARATING AND THROTTLING CALORIMETER
To find the dryness fraction of the steam.

HEAT EXCHANGERS

FHT 301 CONVECTIVE HEAT TRANSFER IN AIR FLOW

To study temperature distribution along the length of fin in both Free & forced convection.

Comparison of theoretical temperature distribution with that of experimentally obtained distribution.

FHT 302 HEAT TRANSFER IN TUBULAR HEAT EXCHANGER

Record temperature curves
In parallel flow mode
In counterflow mode
Determine average heat flux for parallel flow and counterflow operation
Determine average overall heat transfer coefficients

FHT 303 SHELL AND TUBE HEAT EXCHANGER
The main object of the experimental setup is to study the following at various flow rates:
LMTD
Heat transfer rate
Overall Heat Transfer Co-efficient.

FHT 304 FINNED TUBE HEAT EXCHANGER AIR/WATER

Familiarization with the heat transfer process between water and air
Determination of heat flows from water and air
Determination of the efficiency or losses
Energy balances at the heat exchanger

FHT 307 PARALLEL/COUNTERFLOW HEAT EXCHANGER

To calculate the following parameters both for parallel and counter flow arrangement:
Rate of Heat Transfer.
LMTD.
Overall heat transfer co-efficient.
To compare the performance of Parallel and Counter flow heat exchanger.

FHT 309 WET COOLING TOWER

Principle of operation and characteristic variables of a wet cooling tower with forced ventilation.

FHT 310 HEAT EXCHANGER SUPPLY UNIT

Provides the supply and instrumentation to different types of heat exchangers

FHT 310.01 TUBULAR HEAT EXCHAGER

Function and behavior during operation of a tubular heat exchanger
Plotting temperature curves:
in parallel flow operation
in counterflow operation
Calculation of mean heat transfer coefficient

FHT 310.02 PLATE TYPE HEAT EXCHANGER

Function and behavior during operation of a plate heat exchanger
Plotting temperature curves:
in parallel flow operation
in counterflow operation
Calculation of mean heat transfer coefficient

FHT 301.03 SHELL & TUBE HEAT EXCHANGER

Function and behavior during operation of a plate heat exchanger
Plotting temperature curves:
in parallel flow operation
in counterflow operation
Calculation of mean heat transfer coefficient

FHT 310.04 STIRRED TANK WITH JACKET AND COIL

Function and behavior during operation of a stirred tank with double jacket and coil
Plotting time functions:
heating mode with jacket
heating mode with coiled tube

Influence of a stirring machine

FHT 311 COMPARISON OF VARIOUS HEAT EXCHANGERS

Comparison of heat transfer coefficients for concentric tube, shell and tube, and plate heat exchanger.
Demonstration of heat transfer under parallel or counter flow.
Demonstration of batch type heat transfer for jacketed vessel.
Determination heat transfer coefficient.
Effects of flow rate and temperature difference.

FHT 312 HEAT TRANSFER IN FLUIDISED BED

Heat transfer from a heating element to the fluidized bed.

FHT 313 PLATE TYPE HEAT EXCHANGER

Record temperature curves
In parallel flow mode
In counterflow mode
Determine average heat flux for parallel flow and counterflow operation
Determine average overall heat transfer coefficients

INTERNAL COMBUSTION ENGINES

FIC 101 SINGLE CYLINDER FOUR STROKE PETROL ENGINE TEST RIG WITH ROPE BRAKE DYNAMOMETER

To determine Brake Power
To determine fuel consumption
To determine specific fuel consumption
To determine Brake Thermal Efficiency

FIC 101 A SINGLE CYLINDER FOUR STROKE PETROL ENGINE WITH EDDY CURRENT DYNAMOMETER

To determine Brake Power
To determine fuel consumption
To determine specific fuel consumption
To determine Brake Thermal Efficiency

FIC 101.01 DATA ACQUISTION UNIT FOR SINGLE CYLINDER FOUR STROKE PETROL ENGINE

FIC 102/103 THREE/FOUR CYLINDER FOUR STROKE PETROL ENGINE TEST RIG

To determine Brake Power
To determine fuel consumption
To determine specific fuel consumption
To determine Brake Thermal Efficiency

Available with different dynamometers : rope brake, eddy current and hydraulic dynamoeters.

FIC 104A SINGLE CYLINDER FOUR STROKE DIESEL ENGINE TEST RIG

To determine Brake Power
To determine fuel consumption
To determine specific fuel consumption
To determine Brake Thermal Efficiency.

Available with different dynamometers: mechanical, electric and hydraulic dynamometers

Data acquisition unit is also available with the unit as separate item.

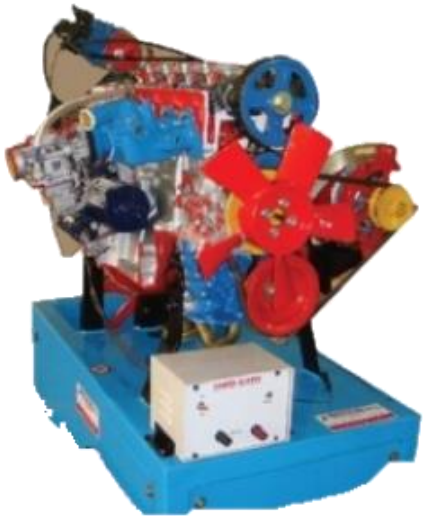
FIC 105 FOUR CYLINDER FOUR STROKE DIESEL ENGINE TEST RIG

To determine Brake Power
To determine fuel consumption
To determine specific fuel consumption
To determine mechanical Efficiency
Also available with different dynamometers mechanical, electric and hydraulic dynamometer

Data acquisition unit is also available with the unit as separate item.

FICM 201 ACTUAL CUT SECTION MODEL OF SINGLE CYLINDER FOUR STROKE PETROL ENGINE (VALVE TIMING DIAGRAM)

FICM 202 ACTUAL CUT SECTION MODEL OF SINGLE CYLINDER FOUR STROKE DIESEL ENGINE WITH VALVE TIMING ATTACHMENT



FICM 203 ACTUAL CUT SECTION OF 4/3 CYLINDER 4 STROKE PETROL ENGINE MOTR DRIVEN

FICM 204 ACTUAL CUT SECTION OF 4 CYLINDER 4 STROKE DIESEL ENGINE MOTOR DRIVEN

FICM 205 ACTUAL CUT SECTION OF 6 CYLINDER 4 STROKE PETROL ENGINE MOTOR DRIVEN

REFRIGERATION AND AIR CONDITIONING LAB

RAC101 SIMPLE COMPRESSION REFRIGERATION CIRCUIT

Fundamentals of a compression refrigeration circuit
Key components of a refrigeration system
Compressor, evaporator, condenser, expansion element
Operation of a refrigeration system / heat pump
Developing a basic understanding of the thermodynamic cycle
Simple energy balance

RAC 102 VAPOUR JET COMPRESSOR IN REFRIGERATION

Understanding compression refrigeration systems based on the vapour jet method
Clockwise and anticlockwise Rankine cycle
Energy balances
Calculation of the coefficient of performance of the refrigeration circuit
Thermodynamic cycle in the log p-h diagram
Operating behavior under load
Solar thermal vapour jet refrigeration

RAC 103 ABSORPTION REFRIGERATION CIRCUIT

Demonstrate the basic principle of an absorption refrigeration system
Absorption refrigeration system and its main components
Operating behavior under load

RAC 104 COOLING USING PELTIER EFFECT

Function and operation of a Peltier element
- For cooling
- As heat pump

Determination of the refrigeration and heating capacity
Recording typical characteristics, such as refrigeration capacity, via temperature differences
Energy balance
Calculating the coefficient of performance

RAC 105 VORTEX COOLING DEVICE

Function and operation of a vortex cooling device
Air flow distribution dependent on the temperature of the cold air flow
Effect of the inlet pressure on heating and refrigeration capacity

RAC 201 REFRIGERATION CIRCUIT WITH VARIABLE LOAD

Design and components of a refrigeration system
- Compressor
- Condenser
- Thermostatic expansion valve
- Evaporator
- Pressure switch

Representation of the thermodynamic cycle in the log p-h diagram
Determination of important characteristic variables
- Coefficient of performance
- Refrigeration capacity
- Compressor work
- Operating behavior under load

RAC 202 ICE PLANT TRAINER

To study the working of Ice Plant.
To Study the refrigerator circuit.

To Calculate Co-efficient of performance

RAC 204 WATER TO WATER HEAT PUMP

Determination of co-efficient of performance of the unit when working as water-to-water heat pump.
To Construction of Energy balances for completed system over a range of operating conditions.
To determine overall heat transfer co-efficient for condenser and evaporator.

RAC 401 AIR CONDITIONING TEST RIG (CONDITIONING OF ROOM AIR)

To study the Vapour Compression air conditioning cycle.
To Calculate Co-efficient of performance- (COP) by the use of P-H diagram.

RAC 402 SPLIT AIR CONDITIONER TEST RIG

Study of layout and process diagram
Observation of pressures and temperatures
Remote control operation

RAC 403 WINDOW AIR CONDITIONER TEST RIG

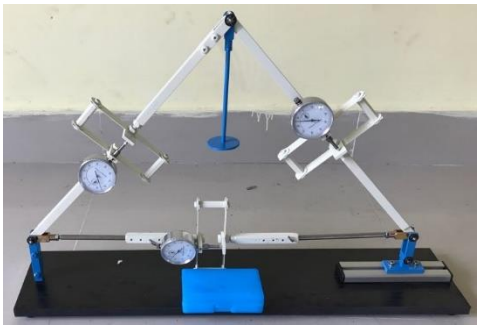
Study of layout and process diagram
Observation of pressures and temperatures
Remote control operation

ENGINEERING MECHANICS

TM 101 FUNDAMENTAL OF STATICS

Accumulation and resolution of forces with force parallelogram
Equilibrium of forces
Law of levers, determination of moments and equilibrium of moments
Combined lever systems
Forces in bearings
Deflection and resolution of force by fixed and free pulleys
Experiments related to:
Inclined plane; friction
Pulley blocks

Gear wheels



TM 102 FORCES IN A SIMPLE BAR STR UCTURE

Measurement of bar forces
Calculation of bar forces by the method of joints
comparison: measuring result – calculation – graphical method

TM 103 EQUILIBRIUM OF MOMENT O A TWO ARM LEVER

Fundamentals of the equilibrium of moments: applied forces, generated moments and equilibrium
Action of forces dependent on the lever arm

TM 104 EQUILIBRIUM OF MOMENTS ON PULLEYS

Fundamentals of the equilibrium of moments: acting forces, generated moments and equilibrium
Effect of forces as a function of pulley diameter

TM 105 EQUILIBRIUM OF MOMENTS ON A DIFFERENTIAL PULLEY BLOCKS

Fundamentals of the equilibrium of moments: acting forces, generated moments and equilibrium
Relation between power savings and cable route

TM 106 FUNDAMENTAL OF MECHANICAL FRICTION

Difference between static and dynamic friction
Friction forces as a function of
Normal force, material pairing, size of contact area
Sliding velocity (relative velocities of the friction partners)
Surface properties of the friction partners
Determine coefficients of friction

TM 108 FRICTION ON THE INCLINED PLANE

Determination of the friction coefficients of various material pairings
Transition from static to dynamic
Static equilibrium of forces on the inclined plane
Determination of the angle of inclination as from which sliding occurs (calculation and verification by experiment)

TM 109 BELT DRIVE AND BELT FRICTION

Effect of wrap angle, coefficient of friction and cable force (Eytelwein's belt friction formula)
Comparison of flat belts and V-belts
Consequences of an unadapted V-belt groove

TM 110 HOOKE'S LAW
Investigation of the proportionality of the active force and the spring deflection
Determination of the spring constant
Series configuration of two tension springs
Investigation of the influence of the spring constant on the frequency of a spring-mass system

TM 201 KINEMATIC MODEL: CRANCK MECHANISM

Crank mechanism with fixed and oscillating cylinder

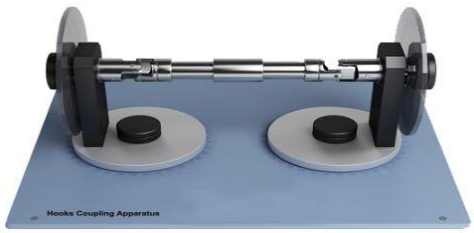
TM 202 KINEMATIC MODEL: CRANCK SLIDER

Conversion of a uniform rotary motion into a purely harmonic reciprocating motion
Influence of crank length and input angle on the output stroke
Recording the transmission function of a crank slider
TM 203 KINEMATIC LINK: FOUR JOINT LINK

Investigation of the mechanical relationships on the

four-joint link
Investigation of the principle of the crank-rocker mechanism, double rocker mechanism and double crank
Verification of the Grashof condition by varying the crank radius, oscillation radius and coupling length

TM 204 KINEMATIC MODEL: WHITWORTH QUICK RETURN MECHANISM
Investigation of a revolving crank slider
Influence of crank length and input angle on the output stroke
Recording the transmission function of a revolving crank slider



TM 205 KINEMATIC MODEL: HOOKE'S COUPLING

Representation of the non-uniform transmission of a universal joint
Determine the gimbal error

How the arrangement of the universal joints and the deflection angle affect the gimbal error

TM 206 KINEMATIC MODEL: ACKERMAN STEERING MECHANISM

Verifying Ackermann's steering principle
Calculate the wheelbase
Determine the lead angle and the steering error

TM 207 KINEMATIC MODEL: GEAR DRIVE

Investigation of single-stage or multistage spur gears
Investigation of planetary gears
Determine the transmission ratio

TM 208 KINEMATIC MODEL: FLYWHEEL

Determine the mass moment of inertia by experiment
Dynamic fundamental law of rotational movement

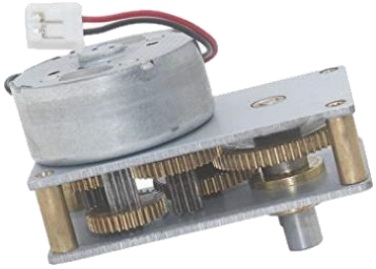
TM 209 ROTATIONAL INERTIA

Investigation of the inertia of rigid bodies in rotational motion
Determine mass moments of inertia of different, regularly shaped bodies
Investigation of the mass moment of inertia as a function of the radius

TM 210 ROLLING DISC ON INCLINED PLANE

Proof of the law of falling bodies on the inclined plane
Influence of the mass of a body on its acceleration

Determine the mass moment of inertia by rolling experiment and pendulum experiment
Steiner's theorem



TM 211 DYNAMIC BEHAVIOR OF MULTISTAGE SPUR GEAR

TM 212 DYNAMIC BEHAVIIOR OF PLANETARY GEAR

Determine the transmission ratio for a locked gear
Measure transmitted forces for a locked gear
Gear acceleration under constant driving torque
Influence of the transmission ratio
Determine reduced mass moment of inertia

Conversion of potential energy into kinetic energy
Determine friction
Determine gear efficiency.

TM 301 CENTRIFUGAL FORCE APPARATUS

Investigation of the centrifugal force as a function of
The speed.
The size of the rotating mass.
The rotation radius.

TM 302 CORIOLIS FORCE APPARATUS

Inertial or apparent force
Interference of a rotational movement on a translational movement
Visualization of the Coriolis force effect

TM 303 GYROSCOPE

Experimental verification of the gyroscopic laws
Familiarization with the three gyro axes
Calculation of gyroscopic moments
Study the effect of precession

TM 304 CENTRIFUGAL GOVERNOR

Kinetics and kinematics of the following centrifugal systems
Porter governor
Poll governor
Hartnell governor
Adjustment of centrifugal governors
Recording the governor characteristic curves and setting curves

TM 401 ROD AND GRAVITY PENDULUM

Oscillation period of gravity and rod pendulum
Determine centre of gravity on the rod pendulum
Reduced pendulum length and centre of inertia of the rod pendulum

TM 402 BIFILAR/TRIFILAR SUSPENSION OF PENDULUMS

Influence of thread length on the oscillation period
Determine the mass moment of inertia

TM 403 TORSIONAL VIBRATIONS APPARATUS

Determine the oscillation period as a function of
The length of the torsion bar
The diameter of the torsion bar
The rotating mass and its shape

TM 404 COIL SPRING VIBRATIONS

Determine the rigidity of a helical spring
Determine the natural frequency of a spring-mass system
Investigate the effect of mass and mass distribution

TM 405 VIBRATION TRAINER

Experiments with pendulums
Kater's pendulum
Reduced pendulum length

Spring-mass system
Bar-type oscillator
Undamped oscillation
Damped oscillation
Forced vibration
Damped and undamped resonance
Absorber effect in multi-mass oscillators

TM 406 FREE AND FORCED VIBRATIONS

Free vibrations
Damped vibrations
Inertia force and displacement excitation
Forced vibrations
Resonance
Amplitude response

TM 407 FREE AND FORCED TORSIONAL VIBRATIONS

- determine the torsional stiffness of a torsion bar
- determine the mass moments of inertia
- decay behavior of torsional vibrations
- determine the damping in torsional vibrations

Forced torsional vibrations, resonance
Torsional vibration systems with multiple masses

TM 408 BENDING ELASTICITY IN ROTORS

Investigate bending vibrations and resonance of a rotating shaft
Determine critical speeds with different arrangements of the bearing and masses on the rotor shaft and compare with theory.

TM 409 ELASTIC SHAFTS (WHIRLING OF SHAFT)

Investigation of
- Critical speed
- Self-alignment

Natural modes on a shaft with continuous mass distribution with
- Different bearing clearances
- Different shaft diameters
- Different shaft lengths

TM 410 STATIC AND DYNAMIC BALANCING APPARATUS

Demonstration of imbalance vibrations at different speeds
Comparison of static, dynamic or general imbalance
Determine an imbalance
Perform a balancing operation

TM 411 INVESTIGATION OF CAM MECHANISM

Elevation curves in non-matching engaging member
Elevation curve in sprung-engaging member
Determine the limit speed and compare with theory
Influence of moving mass on the motion of cam member/plunger
Influence of return-spring stiffness and preload on the motion of cam member/plunger
Comparison of the elevation curves of different cam-member shapes
Comparison of elevation curves with theory

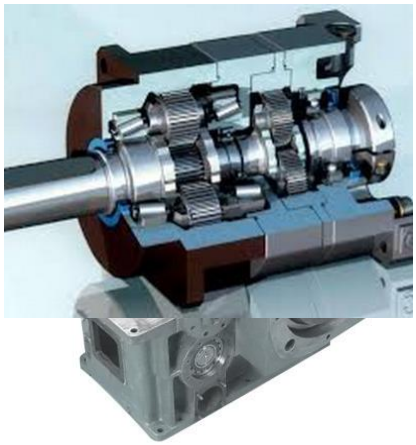
TM 500 CUTAWAY MODELS

TM 500.01 CUTAWAY MODELS: WORM GEAR

TM 500.02 CUTAWAY MODELS: MITRE GEAR

TM 500.03 CUTAWAY MODEL: SPUR GEAR

TM 500.04 CUTAWAY MODEL: TWO STAGE SPUR GEAR



TM 500.05 CUTAWAY MODEL: PLANETARY GEAR

TM 500.06 CUTAWAY MODE: VARIABLE SPEED BELT DRIVE

TM 500.07 CUTAWAY MODEL: CONTROL GEAR

TM 500.08 CUTAWAY MODEL: MULTIPLE DISK CLUTCH

TM 500.09 CUTAWAY MODEL: ELCTROMAGNETIC SINGLE DISC BRAKE

TM 500.10 CUTAWAY MODEL: PEDESTAL BEARING

TM 501 NUTS AND BOLT KIT

TM 502 SCREW LOCKING DEVICES KIT

TM 503 THREAD TYPES KIT

TM 506 ROLLER BEARINGS KIT

TM 507 CAM MECHANISMS

Relation of cam rotation vs follower linear displacement for different types of cam and follower.

TM 508 SPUR GEAR UNIT

Development of the main variables and relationships in a straight-toothed spur gear
Velocity ratios in spur gears
Gear with intermediate wheel or two-stage gear
Influence of gear ratio on friction
Determine the efficiency

TM 509 WORM GEAR UNIT

Mode of operation and layout of a worm gear

TM 510 CABLE WINCH

Determine
- Transmission ratio
- Unwinding rate
- Angular velocity

Efficiency

Behavior under load

STURUCTURE AND MATERIAL TESTING

FST 100 UNIVERSAL TEST FRAME

Supports Structures Experiment Modules, providing a cost-effective platform.

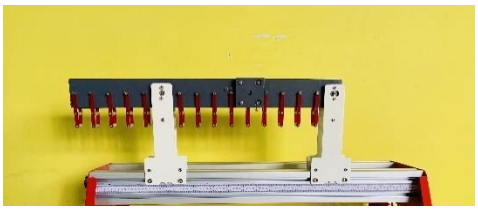
FST 101 DEFLECTION OF BEAMS AND CANTILEVER

Deflection due to point loads and UDLs (uniformly distributed loads).
How beam fixings affect deflection of:
- Simply Supported beams
- Fixed or 'Encastre' beams
- Cantilever beams
- Propped Cantilever

Shape of a deflected beam.
Beam length and deflection.
Beam material and deflection—the Elastic (Young's) Modulus.
Beam cross-section and deflection—the Second Moment of Area ('I' value)
Pure Bending of a beam.
Reciprocal Theorem (Maxwell-Betti).

FST 102 BENDING MOMENT IN A BEAM

Bending moment at the cut due to a varying single point load.
Bending moment at the cut due to a moving single point load.
Bending moment at the cut due to a uniformly distributed load.
Influence lines and superposition.



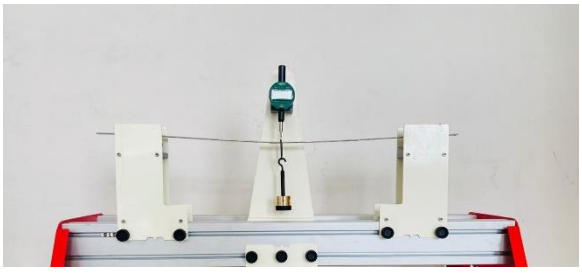
FST 103 SHEAR FORCE IN A BEAM

Shear force at the cut due to a varying single point load.
Shear force at the cut due to a moving single point load.
Shear force at the cut due to a uniformly Distributed load.
Influence lines and superposition.

FST 104 UNSYMMETRICAL BENDING AND SHEAR CENTER

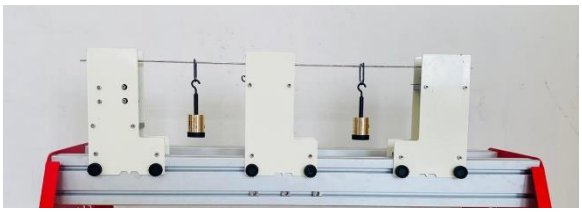
Show that shear centre can be outside beam section boundaries.
Shear centre of an unsymmetrical section.
Horizontal and vertical deflection in symmetrical and unsymmetrical sections at different loads and load angles.
Using Mohr's circle to find Principal Axes and Second Moments of Area.

FST 105 FST 105 EQUILIBRIUM OF A SIMPLY SUPPORTED BEAM



Principle of Moments.
Influence Lines.
Reactions for a point load along a beam.
Reactions for a uniformly distributed load (UDL) on a beam.
The Principle of Superposition.

FST 106 CONTINOUS AND INTERMEDIATE BEAM



Principle of moments.
Reactions for a point load along a simply supported beam.
Reactions for a uniformly distributed load (UDL) on a simply supported beam.
The principle of superposition.
Influence Lines.
Deflection of a simply supported beam.
Reactions for a continuous beam.
Reactions and moments of a propped cantilever.
Reactions and moments of a fixed beam.
The effect of a sinking support.

FST 107 EULER BUCKLING OF STRUTS

Strut length and the collapse load.
Euler's critical load.
Slenderness ratio.
Effective Length.
The collapse load and strut fixings, including:
Pinned-pinned
Fixed-pinned
Fixed-fixed

FST 108 PORTAL FRAME DEFLECTIONS AND REACTIONS

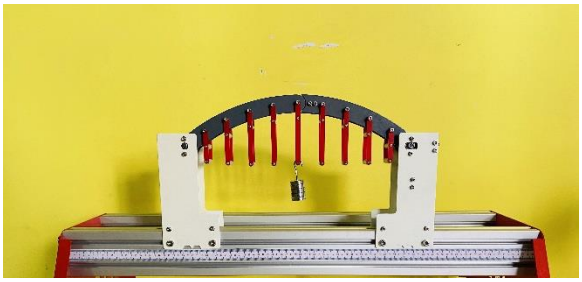
Horizontal reaction and fixing moment due to a varying single point load on a portal frame.
Uniform and non-uniform cross-section portal frames.
Predicting sway direction by consideration of shear forces.

Use of the Moment Distribution (Hardy Cross) Method to calculate bending moments, sway magnitude and horizontal support reactions.
Deflection (sway) of a portal frame due to loading asymmetry.
Deflection (sway) of a portal frame due to asymmetry of the uprights.
Plotting bending moment diagrams.

FST 109 BENDING MOMENT IN A PORTAL FRAME

Strain gauges as instruments.
Relationship between measured strain and bending moment.
Elastic bending of portal frames, and linear relationship between the bending moments in the frame and the load.
Use of the Moment Distribution (Hardy Cross) Method to calculate bending moments, sway magnitude and horizontal support reactions.
The generation and measurement of sway deflections and bending moments around the
Frame due to:
Vertical loads on the beam
Horizontal loads at the junction of the beam and uprights
Moments applied to the uprights
Any combination of the above
Plotting of bending moment diagrams.

FST 110 THREE PINNED ARCH

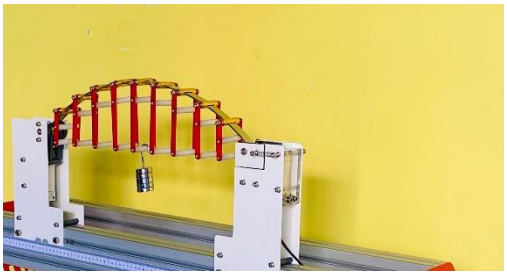


Horizontal reaction due to a varying single point load on a statically determinate structure.
Horizontal reaction due to a moving single point load on a statically determinate structure.
Horizontal reactions due to a uniformly distributed load on a statically determinate structure.
Influence lines and superposition.
Lines of thrust in an arch.
Graphical construction of a bending moment diagram for point loads.
Maximum bending moments due to a load on an arch.

FST 111 TWO PINNED ARCH

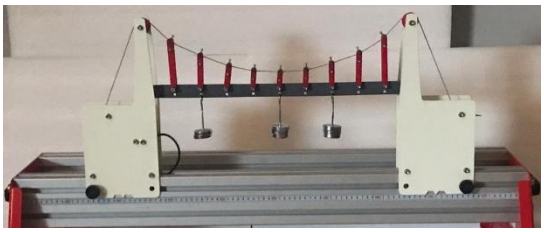
Horizontal reaction due to a varying single point load on a statically indeterminate structure.
Horizontal reaction due to a moving single point load on a statically indeterminate structure.
Horizontal reactions due to a uniformly distributed load on a statically indeterminate structure.
Influence lines and superposition.
Lines of thrust in an arch.
Graphical construction of a bending moment diagram for point loads.
The Secant assumption.
Maximum bending moments due to a load on an arch.

FST 112 FIXED ARCH



Horizontal reaction and fixing moment due to a varying single point load on a statically indeterminate structure.
Horizontal reaction and fixing moment due to a moving single point load on a statically indeterminate structure.
Horizontal reactions and fixing moment due to a uniformly distributed load on a statically indeterminate structure.
Influence lines and superposition.
Lines of thrust in an arch.
The Secant assumption.
Graphical construction of a bending moment diagram for point loads.
Maximum bending moments due to a load on an arch.

FST 113 SIMPLE SUSPENSION BRIDGE



How bridge load affects the tension in a suspension cable.
Comparing a central point load with a UDL.
Exploring the ratio of bridge 'deck' mass and a moving load.
Comparing simple parabola-based theory with a more realistic analysis of the model.

FST 114 SUSPENDED BEAM BRIDGE

Introduction to the suspended beam (or Gerber) bridge.
Support reactions for an increasing point load and a uniformly distributed load (UDL)
How loads affect bridge support reactions and internal reactions between the cantilever and suspended sections.
Influence lines for supports and internal reactions due to a load moving across the beam structure.
The Principle of Superposition.

FST 115 DEFLECTION OF CURVED BARS AND DAVITS

How loads affect the vertical and horizontal deflection of:

- A Quarter Circle
- A Semicircle
- A Curved Davit
- An Angled Davit

Elastic bending.
Comparison of elastic deflection analysis techniques.

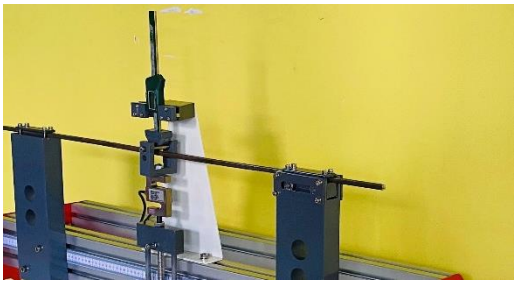
FST 116 TORSION OF CIRCULAR SECTIONS

Torsion formula.
Rod length and angle of twist relationship.
Rod material and angular deflection—the Elastic (Shear) Modulus (G).
Rod cross-sectional dimensions and torsion— the Polar Second Moment of Area (J).
Comparison of angular deflection in similar hollow and solid rods.
Mass per unit length and torsional resistance efficiency of tubes compared to solid rods.

FST 117 PIN JOINTED FRAMEWORK

Introduction to Bow's Notation.
Strain gauges as instruments.
Forces and deflections in different frameworks.
The Warren Truss.
The Roof Truss (or Howe/Pratt Truss).
Simple and advanced Cantilever Trusses
Force analysis by Method of Joints and Method of Sections.
Deflection analysis by the strain-energy method.
Wind loads on a roof truss.
Effect of a swaying load on a cantilever truss
The principle of superposition for multiple loads (needs additional load cell).

FST 118 PLASTIC DEFORMATION OF BEAMS



Elastic bending to plastic deformation of hot rolled mild steel.
How the plastic region moves through the Specimen section as the load increases.
Collapse load and the formation of plastic 'hinges'.
Yield stress.
How beam fixings affect deformation of:

- Simply Supported beams
- Fixed or 'Encastre' beams
- A Propped Cantilever

Shape of a collapsed beam due to hinge formation.
Form or shape factor of a beam and the additional factor of safety it provides.

FST 119 PLASTIC DEFORMATION OF PORTALS

Elastic bending to plastic deformation of portal frames.
Collapse load and the formation of plastic 'hinges'.
Yield stress.
Deformation due to single and combined loads on a portal frame.
Generating an Interaction Diagram.
Shape of a collapsed portal due to hinge formation.
Introduction to Limit State Design.
Shape or Form Factor and the additional factor of safety it provides.

FST 120 BENDING STRESS IN A BEAM
Stress and strain relationship.
Strain gauges as instruments.
Finding the neutral axis by experiment and Calculation.
How the beam cross-section dimensions
Affect the second moment of area (I value) and neutral axis.

FST 121 REDUNDANT FRAME WORK
Strain Gauges as instruments.
Forces within and deflections of:
A truss structure that is statically determinate
A truss structure that is statically indeterminate
Member forces by the Method of Joints and Method of Sections.
Member forces by the use of the strain energy method.
Advantages and disadvantages of both versions of the truss.

FST 122 CABLE UNDER DEAD WEIGHT
determination of the catenary of a free-hanging cable
Under dead-weight only
With additional weights
With a symmetrical setup (chain wheels at same height)
With an unsymmetrical setup
Measurement of the sag
Comparison of calculated and measured values

FST 124 BUCKLING BEHAVIOUR OF FRAMES

Investigation of buckling behavior under the influence of
Different supports and clamps
Different bar lengths and cross-sections
Different materials
Additional lateral load
Testing Euler's theory: buckling on elastic bars
Calculating the expected buckling force with Euler's formula
Graphical analysis of the deflection and the force
Determine elastic modulus for an unknown material (GFRP)
Measure force and deflection
Different cross-section shapes
Eccentric application of force

MECHANICAL OPERATIONS

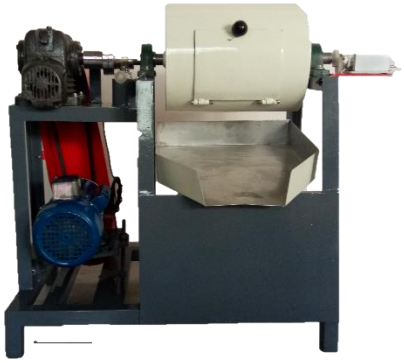
SIZE REDUCTION

MO 101 JAW CRUSHER

To determine the efficiency of the Crusher for crushing a material of known working index.

MO 102 ROLL CRUSHER

To determine the efficiency of the Crusher for crushing a material of known working index.



MO 103 BALL MILL (VARIABLE SPEED)

To study effect of RPM on the power consumption of a Ball Mill.
To determine the efficiency of a Ball Mill for grinding a material of known Wi.

MO 105 ROD MILL

To study effect of RPM on the power consumption of a Rod Mill.
To determine the efficiency of a Rod Mill for grinding a material of known Wi.

SCREENING

MO 106 HAMMER MILL
To demonstrate the working of a hammer mill.

MO 107 VIBRATION SCREEN

Demonstration the working of a vibrating screen.

MO 108 TROMMEL

Demonstration of Trommel.
To study the effect of changing the angle of inclination and RPM.

MO 110 ROTAP SHIEVE SHAKER

MO 111 GYRATORY SHIEVE SHAKER

MO 112 TEST SIEVES WITH DIFFERENT MESH SIZES

SEPARATION

MO 113 CYCLONE SEPARATOR

To study the performance of a given Cyclone.
To study the effect of inlet gas velocity on overall efficiency

MO 115 ELUTRIATOR

To determine the velocity of water for the separation of equal sized particles of different densities.
To determine the velocity of water for separating the given solid mixture of the same density on the basis of size.

MO 116 MAGNETIC SEPARATOR

To study the Principles and operation of a Magnetic Separator.
To determine the efficiency of Magnetic Separator.

MO 117 FROTH FLOATATION CELL
To study the performance of Froth Flotation Cell.
To find % recovery of mineral in froth from a standard mixture.

MO 118 CONE CLASSIFIER
To determine the separation efficiency of given Classifier.
To determine the effect of velocity on separation efficiency.

MO 119 THICKENER
To study the working of continuous type thickener.

MO 120 WILFLEY TABLE

MO 121 MINERAL JIG
To calculate percentage recovery of small particle.

FILTERATION

MO 122 PLATE & FRAME FILTER PRESS
To study the operation of filter press in the laboratory.
To evaluate specific cake resistance and medium resistance.

MO 123 ROTARY VACCUUM FILTER
To study the performance of a Rotary Vacuum Filter.
To study the operation of Rotary Vacuum Filter under vacuum.
To determine the specific cake resistance and medium resistance.

MO124 - LEAF FILTER
To determine the specific cake resistance for the given slurry using Leaf Filter