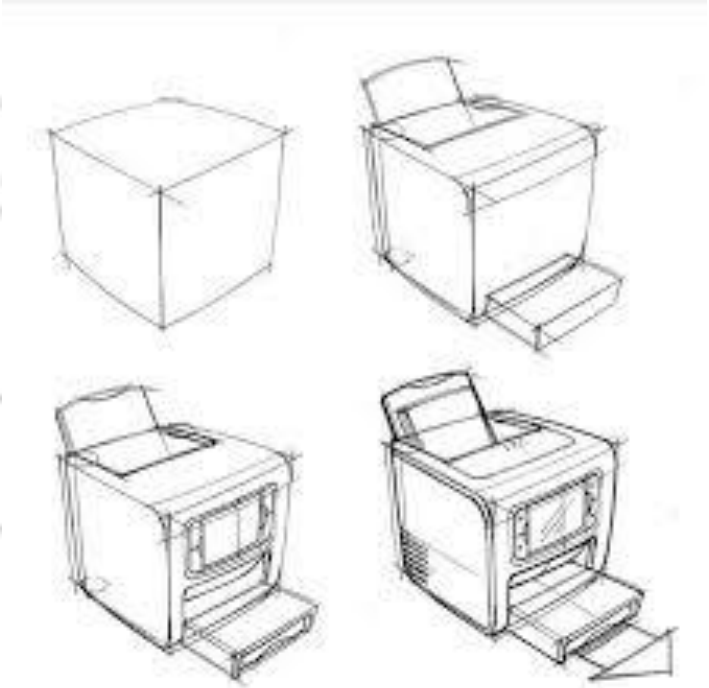
What is design?

- A drawing produced to show the look and function or working of any object before it is made
- Design is how we communicate the functions of an object through its shape or form



- **Inspires people to do many things**

Why?????

- Why does a chair have four legs?
- Why should a chair have a back rest?
- What is the convenient angle of inclination for an easy chair's backrest? Why is it so?
- Why does a fan have three blades?
- Why is a pencil longer than a pen?

Why do we design?

- To meet a need or to find a solution
- Needs are of different types
  - Common individual needs
    - Umbrella, mobile phone, bag, fan, ...
  - Organizational needs
    - Building, power supply, communication system, water supply, sanitation, ...
  - National needs
    - Dams, bridges, towers, communication system, transportation system, ...
  - Universal needs
    - Communication system, transportation, sustainability, solutions for climate changes, global warming.....

Artefact

- **Describes any product of intentional creation**

  - **Physical goods**
  - **Services**
  - **Software**
  - **Graphics**
  - **Buildings**
  - **Landscapes**
  - **Organizations**
  - **Processes**

Design and its Objectives

- **Primary aim of design**
  - **To plan and realize**
    - **a product**
    - **a process or**
    - **a system**

Design and Its Objectives (Contd.)

- **Design objectives**
  - **Most important aspect to be understood before initiating a design**
  - **Defined as a feature or behaviour that we wish the design to have or exhibit**

Design and Its Objectives (Contd.)

- **For example: the objectives of this course are:**
  - **To explain:**
    - **WHY we should learn the Design Process**
    - **HOW to learn it more effectively**
    - **WHAT it IS NOT**
    - **WHAT it IS**

Design and Its Objectives (Contd.)

- **Example 2**
  - **Objectives for designing a portable television**
    - **Light weight (less than 2 kg)**
    - **Easy to handle**
    - **Economical**
    - **It should be able to receive weak signals ….etc.**

Design constraints

- **A constraint**
  - **A limit or restriction**
  - **On the features or behaviours of the design**
- **A proposed design is unacceptable if these limits are violated**

Design constraints (Contd.)

- **Examples**
  - **Maximum length, material expenses, minimum volume, maximum weight etc.**
  - **Tensile strength in steel when building a structure**
    - **< a safe limit**
    - **Before the steel shears or starts to deform and causes distress to the structure**

Design constraints (Contd.)

- **Difference between objectives and constraints**
  - **Design Objectives**
    - o May be completely achieved
    - o May be partially achieved
    - o May not be achieved at all
  - **Design Constraints**
    - o Must be satisfied or the design is not acceptable
    - o Binary – yes or no

Design constraints (Contd.)

- **Difference between objectives and constraints (Contd.)**
  - **Example**
    - o A corn degrainer for farmers made of local materials
    - o One objective
      - » Make it as low cost as possible
    - o One constraint
      - » Limit the cost. Should be less than rupees 600

Design constraints (Contd.)

- **Difference between objectives and constraints (Contd.)**
  - **Example**
    - o A clutch pencil
    - o One objective
      - » To have a smooth surface so that the user can handle it comfortably
    - o One constraint
      - » Length of the pencil

Design functions

- **Design functions**
  - **Fundamental things a designed device or system is supposed to do**
  - **Engineering functions**
    - **Involve transforming or transferring energy, information, or material**
  - **Some functions can lead to constraints**

Design functions (Contd.)

- **Example**

  - **Function of an almirah**

    - **In a child's view**

      - **"It doesn't do anything, it just stands there."**

    - **In an engineer's view**

      - **Two functions**

        - **(1) It resists the force of gravity against the weight of the items kept inside it.**
        - **(2) It ensures the proper keeping of those items with partitions or by its shelf lengths.**
        - **Thus, this almirah does not "just stand there."**

Design functions (Contd.)

- **Classification**
  - **Basic functions**
    - **The main work that the device is intended to do**
  - **Secondary functions**
    - **Additional functions which occur unintentionally while performing the basic function**

Design functions (Contd.)

- **Basic and secondary functions**

  - **Example 1**

    - **A spray which is designed for the basic function of spraying performs a secondary function of polluting the air unknowingly**

Design functions (Contd.)

- **Basic and secondary functions**

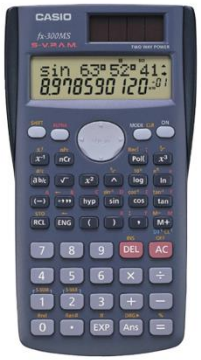
➢ **Example 2**

❖ **An ordinary calculator**

o **Performs the basic mathematical operations of addition, subtraction, multiplication and division**

» **Named as a "four-function" model**

❖ **Advanced calculator**



o **On combining other functions, for scientific, financial, or statistical calculations**

» **Named as "a calculator with 57 scientific functions"**

Design functions (Contd.)

- **Basic and secondary functions**

➢ **Example 3**

❖ **Wristwatch**

o **Basic function**

» **To show the time**

o **Secondary functions**

» **Shows the date too along with the time**

» **Stopwatch**

» **Timer**

Design form

- **Design form**
  - **Shape and structure of the product as distinguished from its material**
  - **Not much to do with the function**
    - **For the same function the shape could be different**

Design form (Contd.)

Automobiles having different forms but serving same function

Design Means

- **Design means**
  - **A way or a method to make a function happen**
  - **Examples**
    - **Small surveys of similar activities and some research are conducted to see the workability of a particular design**
      - **Design of a traffic signal, bus route, ...**
    - **Some features from other designs can be borrowed to make it function as proposed in a particular design**
      - **Making a new product modifying the existing one**
      - **Mobile phone, washing machine, ...**

Design space

- **Every design needs a design space for its working.**
- **Definition**
  - **Imaginary space for design options for a problem**
  - **Created by design functions and means**
  - **Large design space**
    - **Many design options available**

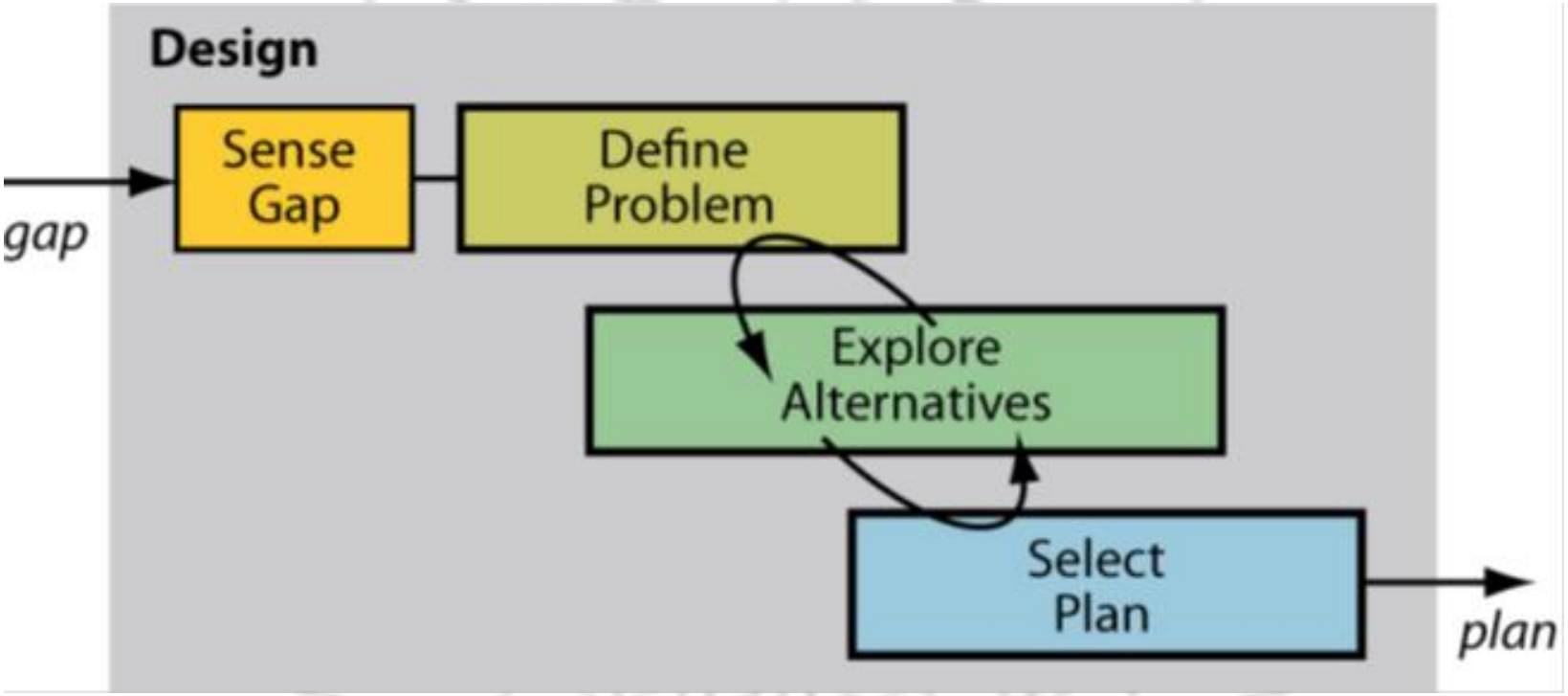
Design space (Contd.)

- **Design space showing both function and means for a container to fill 10 litres of petrol**

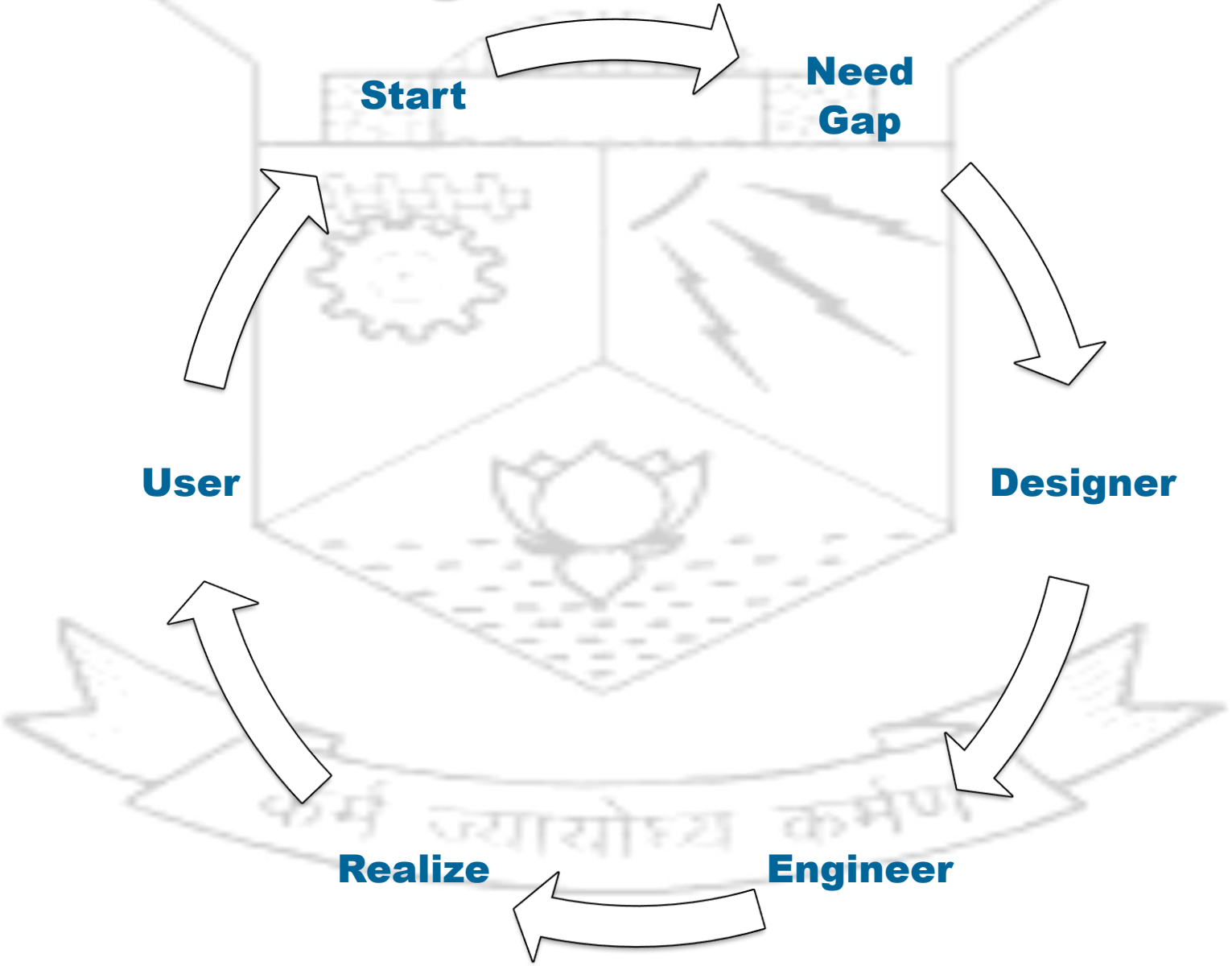
MEANS / FUNCTIONS	1	2	3	4
To contain a fluid	Can	Barrel	Bag	Box
To fill and seal container	Fill and heat seal	Sealed cap	Glue container material	Twist top
To empty the container	Pull tab	Sucking through inserted straw	Twist top	Tear corner
To resist forces	Thick walls	Flexible materials	Sufficiently strong material	X
To identify product	Shape of container	Size of container	Distinctive label	Colour

Creative desgin

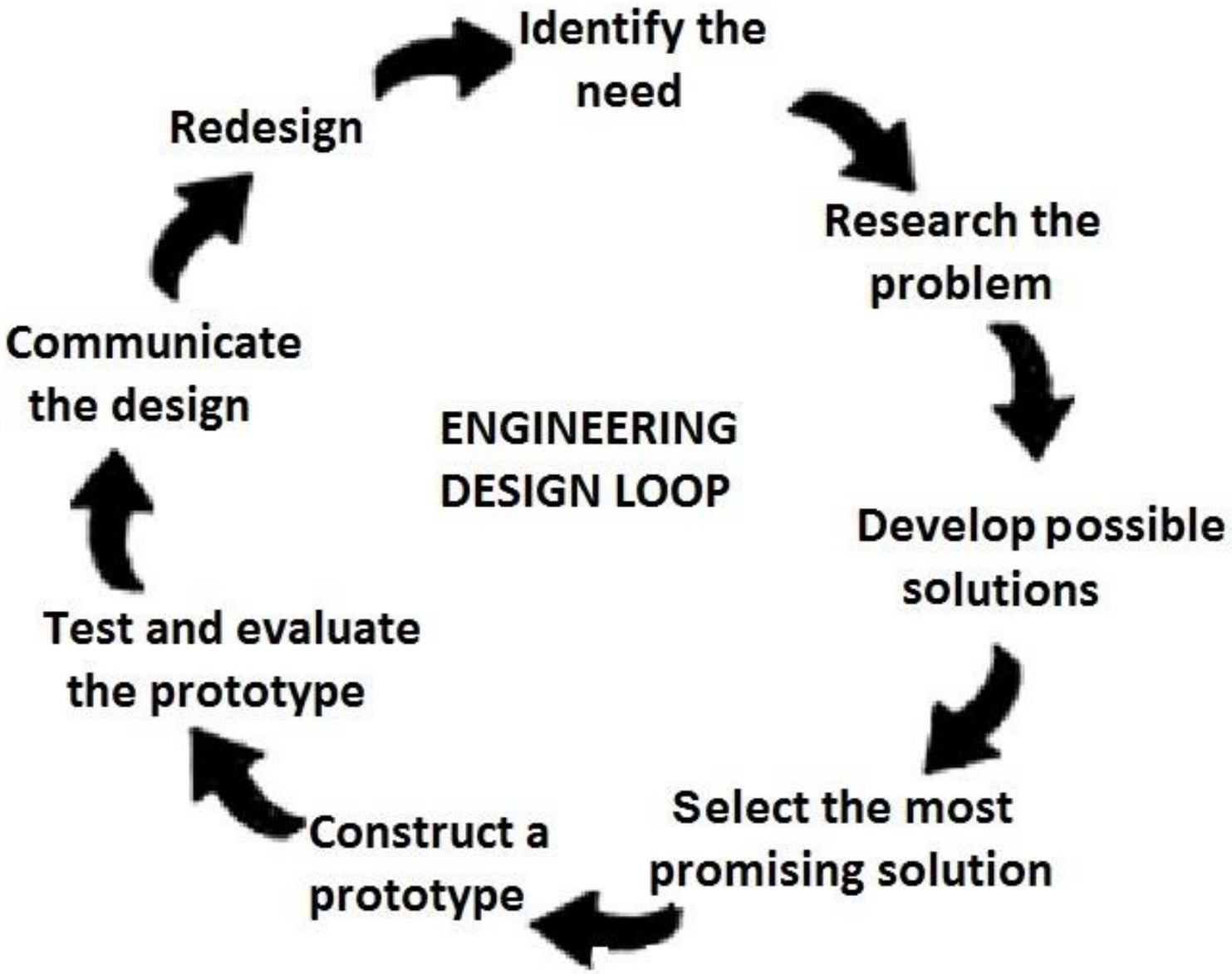
- **Comprises of four information processing steps**



Design framework



Design loop


Identify the need
Research the problem
Develop possible solutions
Select the most promising solution
Construct a prototype
Test and evaluate the prototype
Communicate the design
Redesign
ENGINEERING DESIGN LOOP

Problem statement

- **A statement which talks about**
  - **Clients' intentions or goals**
  - **Design's form or shape**
  - **Design's purpose or function**
  - **Perhaps some things about legal requirements**

Problem statement (Contd.)

- **Example**
  - **Problem statement –"Students need an easy way to take their books to school"**
    - **Now there is the need to define this problem in detail like:**
      - **Who are the students?**
      - **What is meant by easy?**
      - **What are the alternatives available?**

Problem statement (Contd.)

- **Preparation**
  - **Translate the identified needs into**
    - **Meaningful objectives (goals)**
    - **Constraints (limits)**
    - **Functions (what the design has to do)**

EXAMPLE 1

- **Suggest any two design changes for an ordinary soap box that can add value to it.**

EXAMPLE 1 (Contd.)

- **Problem statement**
  - **The present design of a soap box needs to be modified in order to add value to it in the market.**

EXAMPLE 1 (Contd.)

- **Design functions**
  - **To store the soap efficiently**
  - **To drain the excess water in the soap box**
  - **To add value over existing design**

EXAMPLE 1 (Contd.)

- **Design constraints**
  - **It must be leak proof during transit and there must be a facility to drain off water if it is not in transit.**
  - **Compatible size to handle**
  - **Avoid expensive materials as components of soap box**
  - **Durable**
  - **Easily portable**

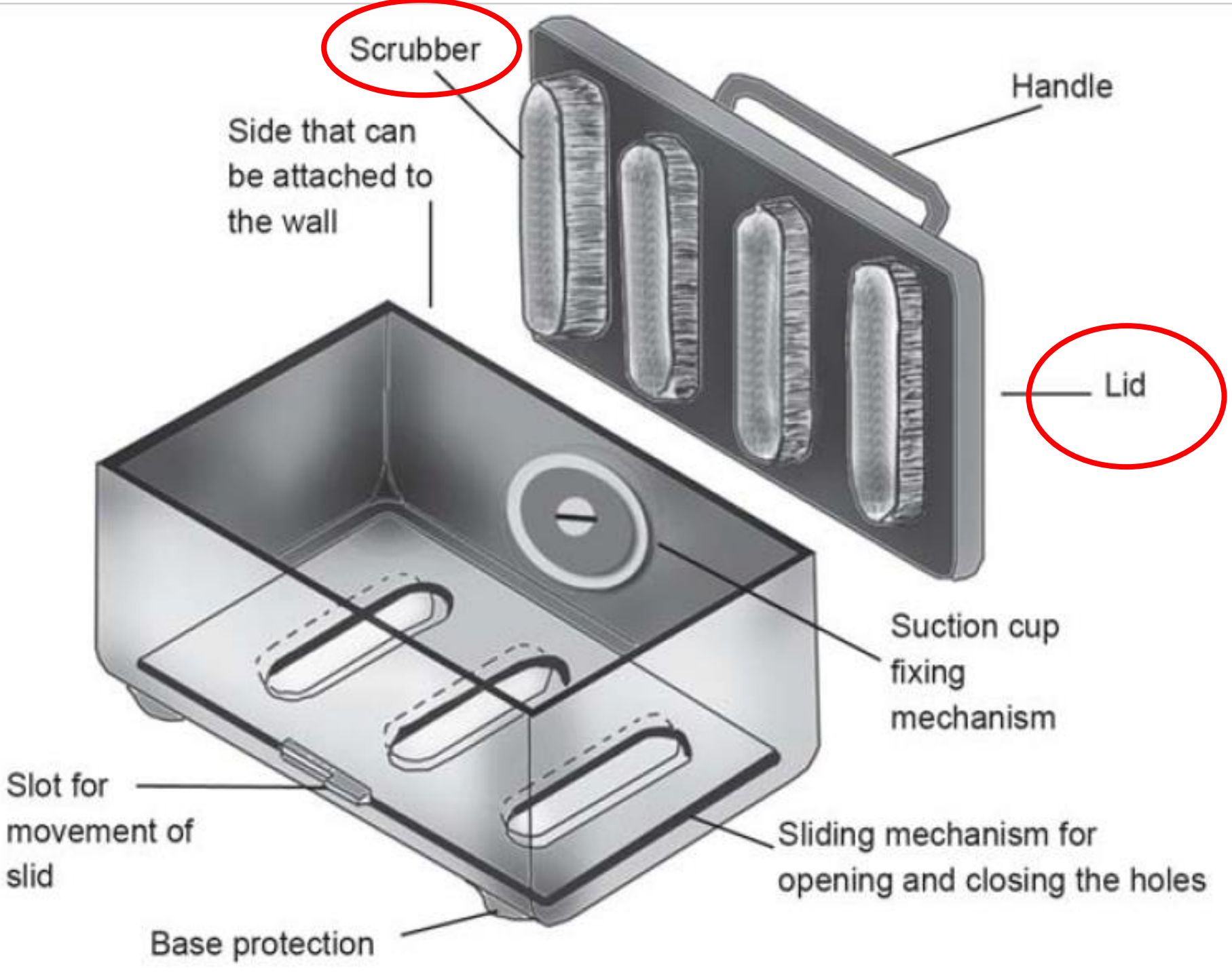
EXAMPLE 1 (Contd.)

- **Design space for a soap box**

Form/Functions	*Means*				
	1	*2*	*3*	*4*	*5*
Shape of soap box	Rectangular base and top with bevelled edges	Hemispherical base and rectangular top	Spherical box	Hemispherical top with rectangular base	Cylindrical box
To keep the soap box dry	Soapbox sealed with a plastic coating	Polyurethane coating inside and outside	Natural bed at the base	Small holes/ elongated gaps given	
To attract the customer	Colour changes	Extra functions like adding scrubber	Changing shape	Reducing size	
For easy handling	Providing pro-jections on base like legs of table	A rivet hole on backside	An air suction cup on the back	A hook on back side	

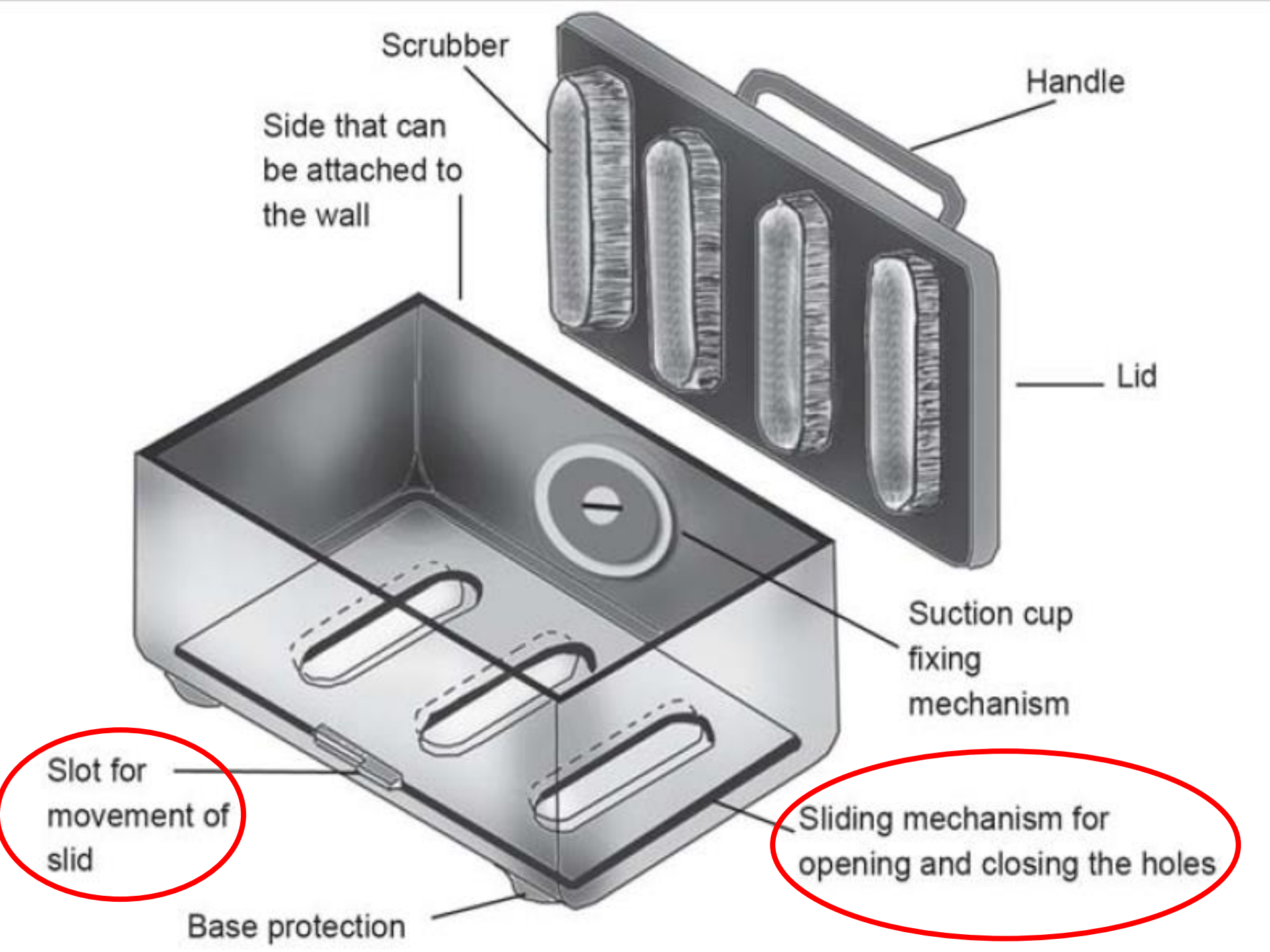
EXAMPLE 1 (Contd.)

- **Design modifications**
  - **A scrubber which also acts as a lid to the soap box can be provided**


Scrubber
Handle
Side that can be attached to the wall
Lid
Suction cup fixing mechanism
Slot for movement of slid
Sliding mechanism for opening and closing the holes
Base protection

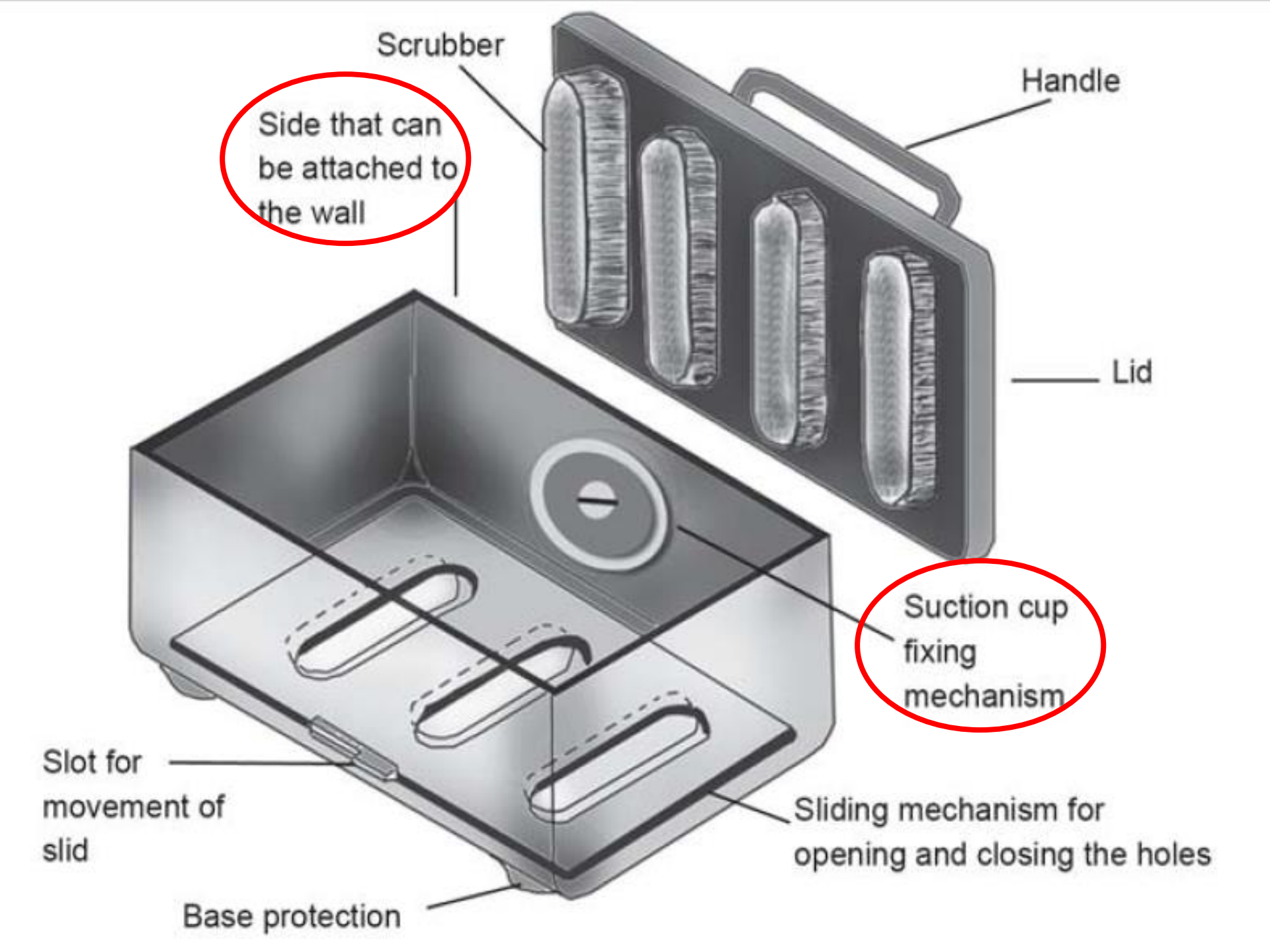
EXAMPLE 1 (Contd.)

- **Design modifications (Contd.)**
  - Holes may be provided at the base to drain the excess water
  - The bottom portion of the soap box may be designed as a thin movable plastic sheet with holes of the same dimensions
    - The main function of this movable sheet is to cover the holes provided at the bottom portion


Scrubber
Handle
Side that can be attached to the wall
Lid
Suction cup fixing mechanism
Slot for movement of slid
Sliding mechanism for opening and closing the holes
Base protection

EXAMPLE 1 (Contd.)

- **Design modifications (Contd.)**
  - **An air sucker may be provided on one side.**
    - **The box can be fixed on the bathroom wall, tiles, wood anywhere by tightening air cup.**


Scrubber
Handle
Side that can be attached to the wall
Lid
Suction cup fixing mechanism
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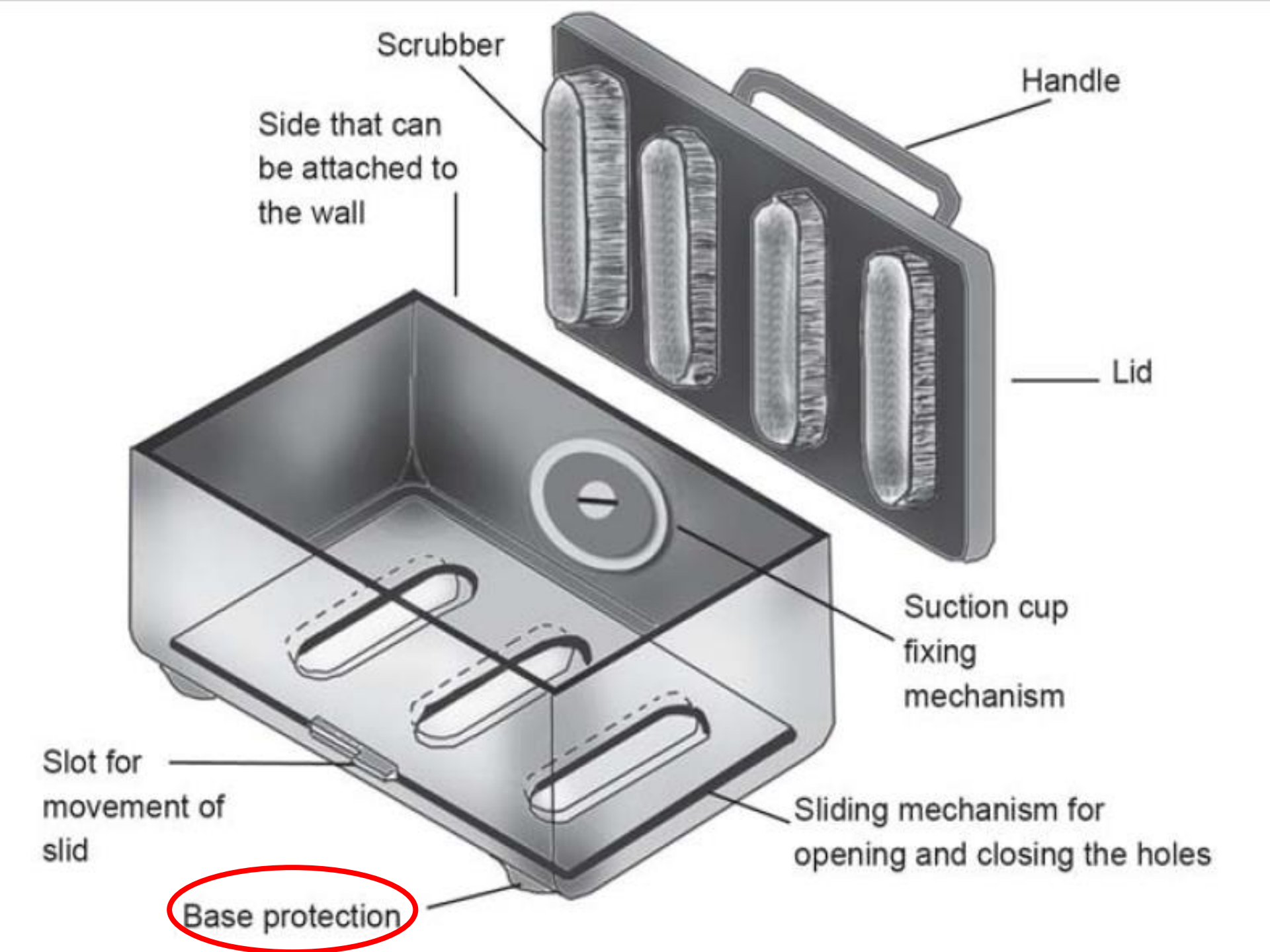
Sliding mechanism for opening and closing the holes
Base protection

EXAMPLE 1 (Contd.)

- **Design modifications (Contd.)**
  - **Some projections may be given at the bottom portion to give stability to the soap box**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Eight sided dice

Eight sided dice