Construction Management through ICT – Development of a Responsive Website

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Abstract

Information technology plays a central role in almost all aspects of daily life. Information and Communication Technologies are changing the way we work and play. Such changes are evident in the design, construction and operation of large construction projects. Programs such as building information modeling (BIM) and various other innovative digital technologies and engineering systems are changing the way we materialize all aspects of construction projects. This proliferation of information technology and digital technologies facilitated the adoption of various innovative approaches in processes and various web based systems throughout a project life-cycle and across its supply chain. Web-based software has changed the face of the construction industry. It has increased sales and efficiencies, all the while decreasing costs and keeping teams better connected. Large or small, construction jobs can be made easier with the right support system, especially when it comes to management software. Clear communication and transparent project management between contractors, teams, and management make for a smooth workflow and better bottom lines for all involved. This study aims in developing a responsive website to perform variety of complex calculations, modelling, management, designing practice and several analysis processes and to manage onsite and offsite operations very quickly.

Keywords — *Information and Communication Technology (ICT), Bugs, Indian Standard (IS) Code, Responsive Website, www.civilsolver.co.in, Programming.*

I. INTRODUCTION

Information technology plays a central role in almost all aspects of daily life. Architecture and Civil Engineering professions relied heavily on the use of PCs (Personal Computers) for design, simulation, analysis and modeling for many years. All these activities are office based and so a live update/change based on field requirement during the execution stage is very difficult [1].

But in the present, explained by Moore's law, tablets and smart phones are becoming increasingly powerful enough to handle such graphic intensive applications. And many types of software that have near equal capabilities as their PC counterparts for Civil and Mechanical applications have made their way into the App eco systems [2].

In the construction industry, the use of mobile devices at various stages of a construction project is on the upswing. In the construction industry having accurate information on the fly is essential to make critical decisions in a timely manner and eventually compete in the industry [3].

In the present era of Information and Communication Technology (ICT) it will be very useful if an online platform is available to connect different personnel of the Architecture and Civil Engineering construction industry [4].

Information and Communication Technologies (ICT) are changing the way we work and play. Such changes are evident in the design, construction and operation of large construction projects. Programs such as building information modeling (BIM) and various other innovative digital technologies and engineering systems are changing the way we materialize all aspects of construction projects [5].

This paper aims in developing a responsive website to perform variety of complex calculations, modeling, drafting, estimating, management, designing practice and several analysis processes and to manage onsite and offsite operations very quickly. This website is specially targeted to site engineers, site supervisors, contractors, skilled labours, engineering students and architects to provide them with vital and helpful information on the current status of their projects and to provide a platform to facilitate effective communication among the pier group such as engineers, contractors and labours. This website will have tools like structural

analyzer, quantity calculator, structural designer, construction diary, estimator, scientific calculator, civil dictionary, cloud storage, compass, open forum, geo-tech, notepad, etc. This website will facilitate not only the calculations but also designing works with maximum accuracy. It is expected that this website will turn as an ultimate solution for almost all civil engineering problems.

II. METHODOLOGY
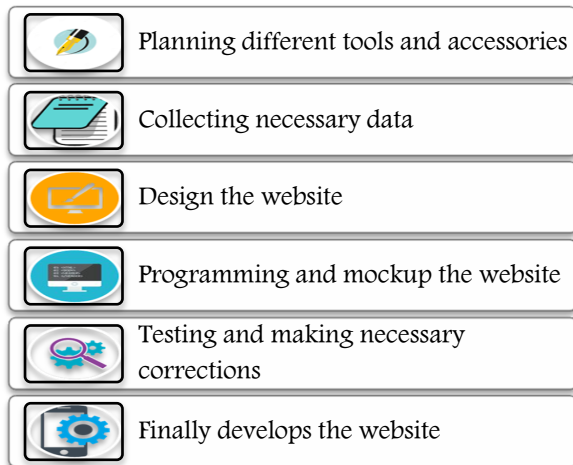
The methodology followed in this study is;

Fig 1. Methodology

A. Planning different tools and accessories required for the website

In the first phase, the necessary ground work for the exact methodology is laid down. During this step the exact market/professional need and the targeted audience are found out. A deep search is carried to see any such other websites exists and if what features they are offering and to figure out the shortcomings. And then planned different tools for the website and how the website to be works.

B. Collecting necessary data for website

Information regarding developing the website, Indian Standard (IS) codes, document collaborative software etc., is collected. And also suitable software, data servers, web domain and programming languages are also collected to develop the website. Generally we collected IS codes like, IS 456:2000, IS 3370:1967, SP 16:1980, etc., and programming tools and languages like Hypertext Markup Language (HTML), Hypertext Processor (PHP), JavaScript, Cascading Style Sheets (CSS), C Language, etc,.

C. Design of the website

In this step different specification of website artifact to be made, intended to accomplish the goals using different primitive components. This step passes through website requirement analysis (WRA) which is a part of the website development process that lists specification used in this website. During this phase of the website development, we designed different tools by tools first in a paper later it converts to digital data for further designing and editing.

D. Programming and mock up website

User interfaces are created which shows how the website will look like and then complete programming is carried to build initial model of website.In this Step of mockup in website development we have to create user interfaces which shows how the website will look like without having to build the website or its functionality and then complete programming is carried to build initial model of website.
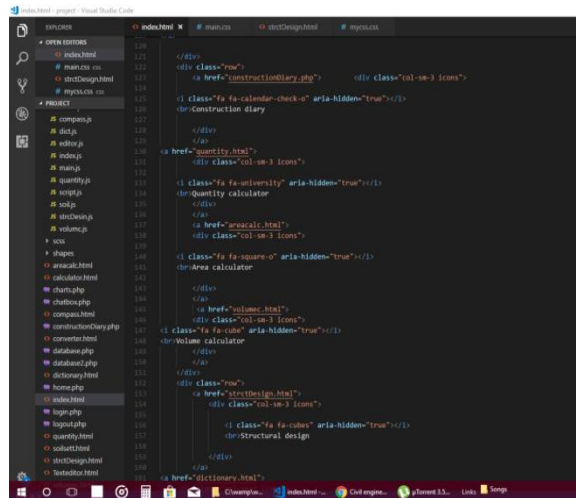

Fig 2. Website in programming stage

E. Testing and making necessary corrections

In this step we carried out a set of activities, where we focus on what it adds what benefits it offers apart from detecting bugs. First we tested our responsive website on different platforms like computers, mobile phones, tablets, etc., with different inputs and checked its working is normal or not and showing the correct outputs, and also the different bugs in the website are noted. Later the noted or reported bugs are fixed to make the final website. This helps to remove maximum corrections and make the website more accurate in its working and complete function able.

F. Developing & publishing the final website

After testing and making necessary corrections and developing the final website with all features we expected, we have to publish the website in internet so that users can easily access and discover our website. For that we first purchased a domain name and then we hosted our website on the internet.

Fig 3. Front page of the website in computer

III.   DEVELOPMENT OF DIFFERENT TOOLS FOR WEBSITE

A. Construction diary

Construction diary is a special tool designed and developed for the easy monitoring, planning, analyzing and controlling of labours, money, materials and time in a construction field. This tool has generally three different stages named planning, execution and project analysis. In the planning stage, the list of data we planned to provide on the project for maximum profit and minimum loss are listed on the tables on the website. Then in the execution stage, the complete list of details of data we actually providing on the project are listed on the table. In the next stage of project analysis, we get a detailed graphical comparison of the project we planned and executed. This tool will helps for the better management of the construction projects.
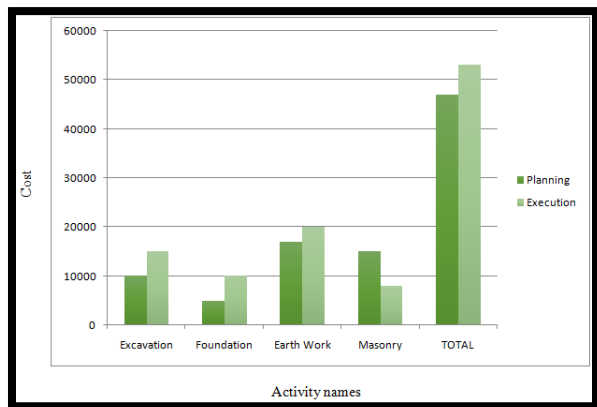
Table 1. Planning

Sl. No.	Activity	Schedule		No. of days	Labours		Materials		Cost
		From	To		Type	Nos.	Type	Nos.	

Table 2. Execution

Sl No.	Activity	Schedule		No. of days	Labours		Materials		Cost
		From	To		Type	Nos.	Type	Nos.	
	(Automatically fill with respect to planning)								

Table 3. Project analysis

B. Soil specification

This tool is provided to easily determine the important specifications of the soils. The information in this tool can be used by civil engineers to determine whether it is suitable for a certain type of construction or what type of soil management might be required. A homeowner may even be able to use the information for maintaining or constructing their garden, yard, or home.

1) *Input*:
1. Enter the volume of the moist soil, $(v1) = $ ------- m^3
2. Enter the mass of the moist soil, $(M1) = $ --------- kg
3. Enter the mass of dried soil, $(M2) = $ --------- kg
4. Specific gravity, $(G) = $ ----------
    2) *Output:*
5. Mass of the water in soil, $(m) = M_1 - M_2 = $ --------- kg
6. Water content, $(w) = (^m/_{M2}) = $ -----------
7. Bulk density of moist soil, $(\rho sat) = {}^{M1}/_{v1} = $ ---------- kg/m^3
8. Dry density of the soil, $(\rho d) = {}^{m2}/_{v1} = $ --------- kg/m^3
9. Void ratio, $(e) = (^{G*1000}/\rho d)-1 = $ ----------
10. Porosity, $(n) = (^e/_{1+e})*100 = $ ----------- %
11. Degree of saturation, $(S) = {}^{W*G}/_e = $ ---------

C. Settlement of foundation

This is a simple and compact tool for determining the settlement of footings. This tool helps to determine the amount of settlement made by the footings under loading.

1. Enter the angle of distortion (T) = ----------
2. Enter span (L) = ----------- m
3. Settlement, (S) = $T*L*10^3$ = ----------- mm

[Note:-to avoid architectural damages, angle of distortion (T) should be Less than ($^1/_{300}$)]
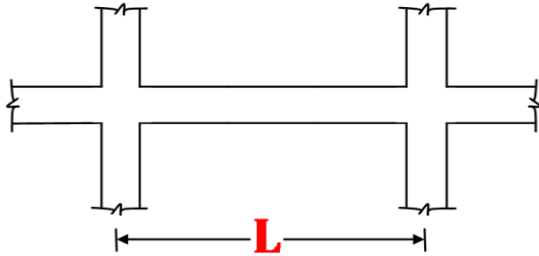

Fig 2. Footing

D. Unit converter

This tool is a simple and friendly unit converter with a clean user interface. This tool helps to convert different quantities of different units. It includes a favorites list for easy access to commonly used conversions and a Quick List View for an at-a-glance view of all conversions.
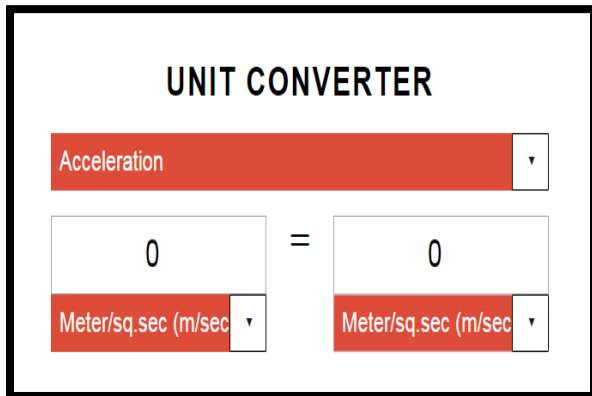
**Fig 4. Unit Converter**

E. Area calculator

This is an another simple and compact tool for calculating the areas of different shapes. This tool provides maximum accuracy in calculation and determines the areas of many different shapes.
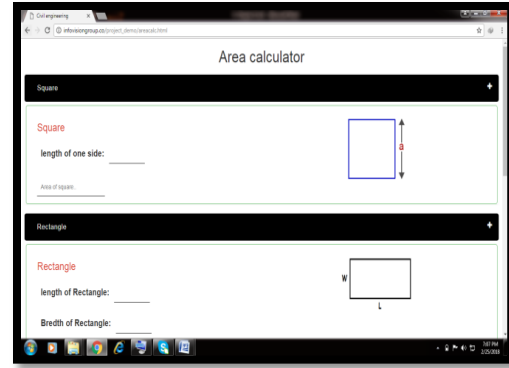
Fig 5. Area calculator

F. Volume calculator

This is an another simple and compact tool for calculating the volumes of different shapes. This tool provides maximum accuracy in calculation and determines the volumes of many different shapes.
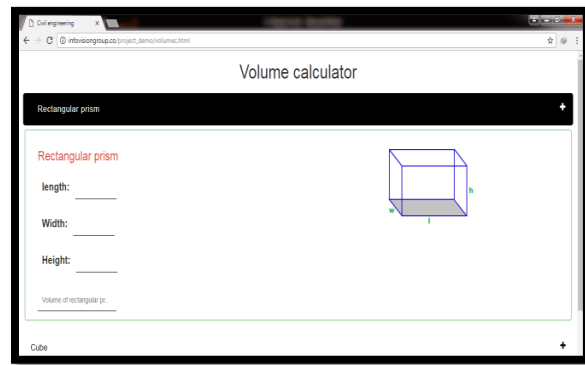
Figure 6. Volume Calculator

G. Quantity calculator

This is the tool we developed to calculate the amount of different materials and their ingredients are required for the completion of a particular work. In this tool, we can calculate the quantities of cement, sand, course aggregates and water required for concreting, the number of bricks and amount of sand and cement required for brick work and also the number of tiles required for flooring.

1)   Brick quantity
1)   Input:

1. Size of brick, = l*b*h = _____ cm
2. Mortar thickness, = _____mm
3. Length of wall, l =_____ m
     2)   Output:
1. Area of brick work, A = l*b = _____m²

2. Width, b = _____m

3. Height of wall, h = _____m

4. Brick work volume, $x = l*b*h$ =_____m³

5. Volume of 1 brick with mortar, i =_____m³

6. No. bricks required for x m³, $y = x / I$ =_____ nos.

7. Volume of 1 bricks without mortar, $k = (l*b*h) / 100$ =_____m³

8. Volume of "y" bricks without mortar for x m³, $z = y * k$ =_____m³

9. Required amount of cement mortar (in wet condition), $w = x – z$ = _____m³

10. Required amount of cement mortar (in dry condition), $A = w*1.33$ = _____m³

11. Mortar ratio ___1___ : ___6___(enter)

12. Required amount of cement quantity in brick work = $A*(1/7)*1440$ =_____kg

13. No: of cement bag required, $C = B/50kg$ =_____Nos

14. Required amount of sand quantity in brick work =$A*(6/7)-(1:6)$ = _____ m³

2) Tile quantity

1. Length of room, l = _____ m

2. Breadth of room, B=_____ m

3. Area of room, $A = l*B$ =_____ m²

4. Door size =__a__,__b__ m

5. Perimeter of room, $Y = (l+B+l+B) – b$ =_____m

6. Skirting tile height = _____ m   (4 inch default)

7. Skirting tile area, $A = y*0.1016$ = _____ m²

8. Total area to be laid, $B = x+A$ = _____m²

9. Size of tile =__p__,__q__

10. Area of tile, $C = p*q$=_____ m²

11. Wastage =5% (enter)

12. No of tiles required, $D = (B/C) + [(B/C)*(5/100)]$ = _____Nos.

3) Concrete ingredient

1. Volume of concrete, x =_____m³

2. Concrete mix (grade) _____ (enter) in ratio _____ (enter)

3. Cement quantity=$C/5.5*x$=_____m³

4. Wight of cement = $y*1440$ =_____

5. No: of bags = $z/50$=_____ Nos

6. Sand quantity = $s/5.5*x$=____m³

7. Coarse aggregate = $C.A/6.5*x$ =___m³

8. Water cement ratio = _____ (enter)

9. Amount of water = w/c ratio * y =____m
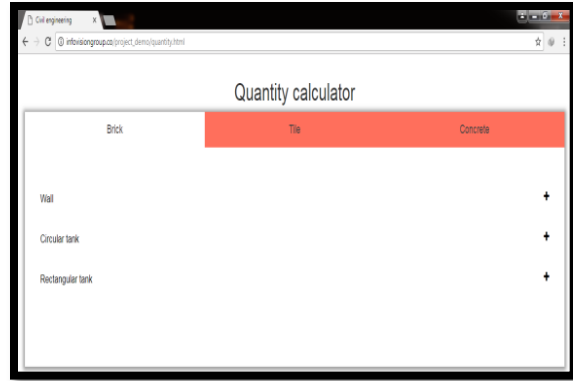
10. Amount of water = $c*1000$ =_____ liters

Fig 7. Quantity Calculator

H. Civil dictionary

This tool is equipped with quick dynamic search function, that the dictionary will start searching for the words while you type. In this website we added more than 1000 words including all the popular and daily use civil engineering terms in the dictionary. And also this tool is fully compatible and can work perfectly fine on most of the devices.

It is very simple and easy to use interface. The tool comes with a user friendly function, allowing you to use with ease. In addition, all the terms are listed alphabetically with faster search facility. In general this tool will work as a great pocket resource for Civil Engineering terms and definitions.

Fig 8.Civil dictionary in website

I. Scientific calculator

This is an online JavaScript scientific calculator. You can click the buttons and calculate just like a real calculator. Its unique design allows you to comfortably write complicated equations, while also enabling you to compose short and simple calculations fast. Unparalleled in features, its one-screen functionality makes it one of the simplest yet powerful calculators you will ever have the pleasure of operating.
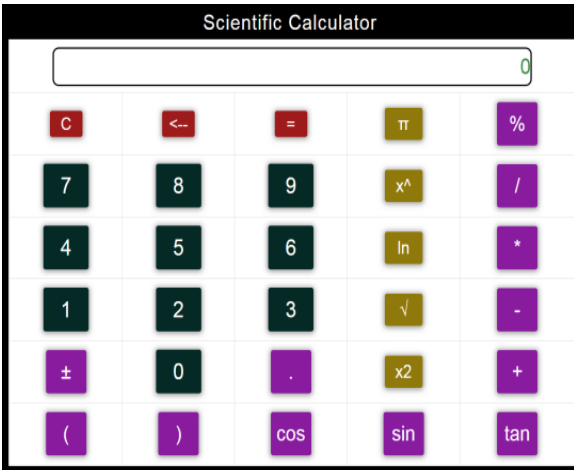
Fig 9. Scientific Calculator

J. Text editor

A good way to edit text is by choosing our text editor. It's a unique editor that allows you to create documents online. This is an open source ODT file support tool. The editor provides all the basic functions for word processing: font type, size, and many more. These tools reflect the latest trends in online services. This is also a free service.

Fig 10. Text Editor

K. Online compass

Compass is one of the essential tools every civil engineer should have especially during surveying. This Compass is the most precise compass tool on internet. Compass tool is a compass in your pocket. Use it on camping trips, to navigate in unknown territory or when you get lost. You never know when it might come handy.

This compass is easy to use; just use it like a real compass. Compass tool is more than just showing degrees and north, south, east and west. I have designed Compass with user experience in mind, large numbers

and easy to read design. Compass also allows you to set your directions by rotating the bezel for easier and professional navigation. But this compass will only work perfectly on devices having "magnetometer" sensor.
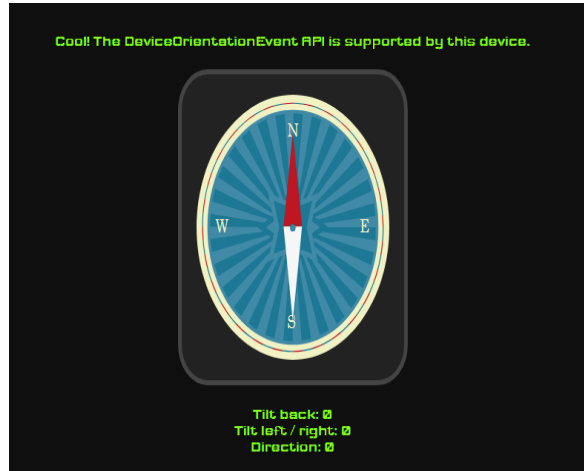

Fig 11. Online compass

L. Open forum

This is an online discussion platform where people can hold conversations in the form of posted messages. They differ from chat rooms in that messages are often longer than one line of text, and are at least temporarily archived. Users have to register with the forum and then subsequently log in, in order to post messages.
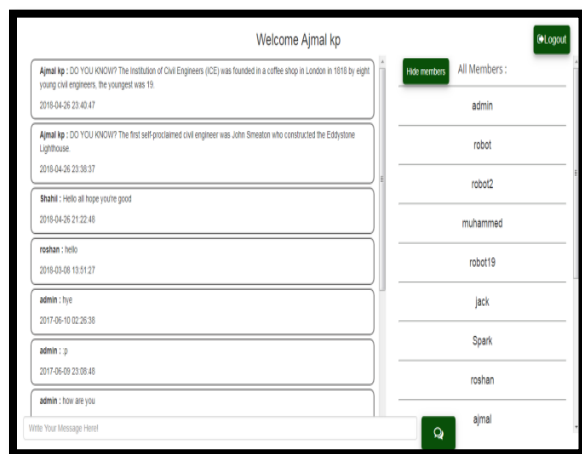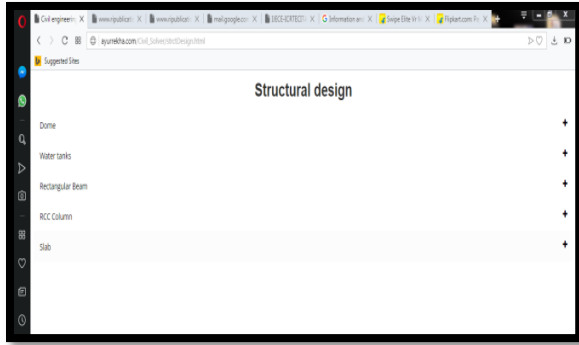

Fig 12.Open forum

M. Structural design

Structural design is a powerful tool developed to design partially or completely different structures

like beams, columns, slab, water tank, dome, etc. with respect to IS (Indian Standard)codes.

Fig 13.Structural design

IV. CONCLUSION

Information and Communication Technology (ICT) plays a central role in almost all aspects of daily life. By taking advantages of the ICT, the engineers can explore a greater number of design options in a short period of time. It allows engineers to make immediate comparisons and see the impact of each decision and also increase your overall effectiveness. This project aims in developing a responsive website to perform variety of complex calculations, modeling, drafting, estimating, management, designing practice and several analysis processes and to manage onsite and offsite operations very quickly. Implementing a fully integrated and automated construction website solution helps construction companies become more efficient and ultimately leads to improved profitability. It will be highly appreciable if a website is developed which enables construction managers to input, store, process, and access project information from any location and to communicate that information to any other location through the use of personal computers and mobile computing devices.

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