

CONSTRUCTION INJURY DATA RECORDING AND ANALYSIS TOOL

By

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To my mom, Veena R. Gholap and my dad, Ramakant G. Gholap

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TABLE OF CONTENTS

	<u>page</u>
ACKNOWLEDGMENTS.....	4
LIST OF TABLES.....	7
LIST OF FIGURES.....	8
ABSTRACT	9
CHAPTER	
1 INTRODUCTION	10
Statement of the Problem	10
Objective.....	11
2 LITERATURE REVIEW	12
3 METHODOLOGY	20
4 MICROSOFT ACCESS.....	24
Creating the Database	25
Creating a File	25
Creating Tables and Columns	26
Creating Form for Data Input	27
Creating a Drop Down List.....	28
Adding Buttons	28
Generating a Query	29
Creating Report	30
Graphical Representation	31
5 CASE STUDY: ANALYSIS OF FIRST AID INJURY DATA.....	43
Based on Body Part Injured	43
Based on Day of the Week and Time	44
Based on Months.....	44
Based on Cause of Injury.....	45
Based on Nature of Injuries	46
Based on Trade	47
6 ADVANTAGES AND LIMITATIONS	57
Advantages.....	57
Limitations.....	58

7 CONCLUSIONS AND RECOMMENDATIONS.....	59
LIST OF REFERENCES.....	60
BIOGRAPHICAL SKETCH.....	64

LIST OF TABLES

<u>Table</u>		<u>page</u>
5-1	Number of injuries based on body parts and OSHA recordable criteria	54
5-2	Number of injuries based on days of week and time of day	54
5-3	Number of injuries for specific causes of injuries.....	55
5-4	Number of total injuries for different natures of injuries	55
5-5	Number of injuries to workers performing different trades	56

LIST OF FIGURES

<u>Figure</u>	<u>page</u>
4-1	Creating a new file in Access 2010 for creating a new database 32
4-2	Creating new table and column for the database 33
4-3	Over view of an Access table with columns formatted and data entered..... 34
4-4	Form Wizard to design form for data input 35
4-5	Form for data input with embedded blank fields and drop down menu option.... 36
4-6	Table generated for fields to be embedded in drop down menu for selection during data input..... 36
4-7	Wizard for generating need based simple query 37
4-8	Layout of a query with selected fields and desired output information..... 38
4-9	Output of a query based on two desired fields of trade and nature of injury 39
4-10	Output of a crosstab query giving summary of number of injuries based on months of the year and days of the week 40
4-11	Report generated extracting injury number based on month, day and then body part injured giving numbers and percentages with respect to total number of injuries recorded and stored in the database..... 41
4-12	Steps for exporting the data in Excel for making graphs 42
5-1	Body part injured v/s OSHA recordable criteria 48
5-2	Number of injuries based on days of week and time of day 49
5-3	Numberof injuries based on months of the year 50
5-4	Number of injuries for specific causes of injuries..... 51
5-5	Total injuries for different natures of injuries 52
5-6	Number of injuries to workers performing different trades 53

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First Aid construction worker injuries are minor injuries that are not reported as Occupational Safety and Health Administration (OSHA) recordable injuries. Most construction firms do not track or record first aid injuries. As a result they have no means of analyzing these injuries. If the causes of first aid injuries are not prevented potentially serious injuries may be incurred in the future. There are no readily available efficient methods for recording first aid injuries of construction worker. It is important to look into the causes of the construction worker first aid injuries so preventive measures can be implemented to avoid more serious injuries in the future.

This study was conducted to generate a readily available database model, using Microsoft Access 2010 to record the first aid injuries sustained by construction workers on a construction site and to analyze the factors associated with the construction injuries. The first aid injury data from large construction firms were used as a case study to test the model by analyzing the first aid injury data. The model shows that data can be easily input and that meaningful information regarding the injuries can be readily retrieved.

CHAPTER 1 INTRODUCTION

Construction worker first aid injuries are less serious than Occupational Safety and Health Administration (OSHA) recordable injuries. There is a no requirement that first aid injuries be monitored or even documented. By not maintaining this information, valuable information is not retrieved. The information could provide valuable insights about injury causation which could be utilized to implement preventive measures. By addressing the causes of minor injuries, future serious injuries might be prevented. Causation factors include nature of injury, cause of injury, body part injured, day of injury, time of injury occurrence and so on. These factors provide potentially valuable information for preventing future injuries. If the cause of the first aid injury is not rectified, the cause could lead to a future injury of a more serious nature. For example a minor eye injury due to the use of inappropriate protective eye wear could result in a major injury at a subsequent occurrence. A data recording and analysis mechanism could be valuable aid in preventing injuries and in bolstering a safety program.

Statement of the Problem

There are no readily available efficient methods for recording construction worker injury data. The commercially available programs tend to be costly and many require ongoing maintenance by the provider. First aid injuries are not typically included in injury records because OSHA only mandates injury documentation for the more serious OSHA recordable injuries. The causes of first aid injuries, if not prevented, can subsequently result in serious injuries. It is important to examine the causes of construction worker first aid injuries to prevent them and thereby avoid more serious injuries in the future. Also, first aid injuries result in additional costs in the construction

work in terms of worker hours and property damage. To prevent these injuries it is important to record them consistently and analyze them extensively, especially in terms of the nature, cause and preventive measures. At the same time it is necessary to make the recording procedure a simple process so that no special training is required to record the injuries. Even though a substantial amount of research has been done dealing with OSHA recordable injuries, little research has been conducted on the topic of first aid construction worker injuries, their nature and causes, and how to record the injuries effectively and efficiently in a simple manner.

Objective

The objectives of this study are to achieve the following:

- Develop a recording and analysis type database model to record first aid and OSHA recordable injury data.
- Develop the ability to easily analyze the injury data in terms of injury cause and nature and to generate common statistical information of interest.

CHAPTER 2 LITERATURE REVIEW

The construction industry is statistically one of the most hazardous industries based on the aggregate number of fatalities in many countries (Carter & Smith, 2006; Wang, Liu, & Chou, 2006; Camino, Ritzel, Fontaneda, & González, 2008). Safety problems on many construction sites seem to be largely unresolved as the fatality and injury records in construction continue to plague the industry across the world (Hinze and Bren, 1996; Abdelhamid and Everett, 2000; Fang et al., 2004; Carter and Smith, 2006; Aneziris et al., 2008). Safety studies have conducted to identify the causes of injuries and to better understand safety hazards and risks. These studies have generally been conducted to prevent fatal and serious injuries on construction sites. Accident causation models and human error theories have evolved through this past research, such as the Domino Theory (Heinrich, 1959) and Reason's Model of Human Error (Reason, 1990). Sawacha et al. (1999) analyzed the factors influencing safety on construction sites including historical, economic, psychological, technical, procedural, organizational and environmental issues. Abdelhamid and Everett (2000) thought that construction accident investigations had missed important steps for identifying the root causes of accidents and presented an accident root causes tracing model. Suraji et al. (2001) proposed a conceptual but practical model of accident causation for the construction industry, which included management and organizational aspects of accident causation.

Fang et al. (2004) found that safety management performance on a construction site was closely related to organizational factors, economic factors, and factors related to the relationship between site management and labor. Teo et al. (2005) pointed out

that site accidents were more likely to happen when there were inadequate company policies, unsafe practices, poor attitudes of construction personnel, weak management commitment to safety and insufficient safety knowledge and training of workers. A model based on an ergonomics systems approach indicated the manner in which originating managerial, design and cultural factors shaped the circumstances found in the work place, giving rise to the acts and conditions which, in turn, lead to accidents (Haslam et al., 2005).

The building and construction industry is unique and challenging to study. This is due to the variable nature of work tasks, trades, and environments, as well as the temporary and transitory nature of construction workplaces and the construction workforce. Work-related injuries and illnesses occur at relatively high rates in the construction industry. According to the U.S. Bureau of Labor Statistics (BLS), the construction industry experienced an incidence rate of 5.4 total recordable injuries and illnesses and 190 cases with days away from work per 100 workers in 2007 (BLS, 2008). Construction laborers consistently rank high on lists of occupations that contribute to diseases (Leigh & Miller, 1998). It has also been demonstrated that the allocation of cost and severity of injuries and illness in the construction industry is likely underestimated (Glazner et al., 1998).

The safety of any operation is determined long before the people, procedures, and equipment come together at the work site (Stephenson, 1991). Construction operations are not different in this respect from any other operation (e.g. manufacturing, distribution, etc.). It is often considered by construction industry safety professionals that many safety hazards are “designed into” construction projects (Gambatese, 2003).

A review of the literature on construction safety reveals that significant research effort has been directed at examining accident records to categorize the most common types of accidents that occur to a specific trade, and how these accidents happen (Fullman 1984, Goldsmith 1987, MacCollum 1990, La Bette 1990, Rietze 1990, Davies and Tomasin 1990, Peyton and Rubio 1991, Helander 1991, Culver et al. 1992, Hinze 1997). Despite the importance of such study findings to guide accident prevention plans, construction accident investigations appear to conclude at a premature level or are missing important steps to identify the root causes of accidents. As summarized by Brown (1995), "Accident reporting is a means to an end, not an end in itself". Despite the contributions of these causation models to both understanding accidents and current safety programs, no model provides an understanding of the underlying causes of construction accidents sufficient to prevent the kinds of accidents that now plague the industry.

Besides causing human tragedy, construction accidents also delay project progress, increase costs, and damage the reputations of contractors (Wang et al., 2006). Formal identification of hazards in the workplace is one of the foundations of successful safety management (Trethewy, Atkinson, & Falls, 2003; Carter & Smith, 2006) and an essential component of occupational health and safety (OHS) legislation (Trethewy et al., 2003). However, the findings of Carter and Smith (2006) indicate that current hazard identification levels on construction projects are far from ideal. These authors identified several significant barriers to improving hazard identification: knowledge and information barriers (e.g, failure to share information across projects, lack of resources in smaller projects, subjective hazard identification and risk

assessment, and reliance upon tacit knowledge), and process and procedure barriers (e.g., lack of a standardized approach, and undefined structures for tasks and hazards).

The work environment in construction is by nature dynamic; occupational exposures change as the project progresses. A number of different trades are typically simultaneously present on site, often performing tasks in close proximity, and potentially creating hazards for one another. Manual materials handling is common in construction and often involves carrying, pulling, or pushing large, heavy objects that may views obstruct the workers.

Fiske (1999) reported that the outcome of occupational injuries depends not only on the severity of the injury but also on the prompt rendering of first aid care. Properly administered first aid can mean the difference between life and death, rapid versus prolonged recovery, and temporary versus permanent disability. Research has also identified an association between traditional first aid training and a lower incidence of workplace injuries (McKenna & Hale, 1981; Miller & Agnew, 1973).

Fatal and severe injuries have generally been given high priority in occupational injury prevention strategies employed by national authorities (Silverstein, 1998). This injury severity-based approach is partly motivated by the social and economic consequences for the severely injured persons, and the focus is on the prevention of serious injury types such as fatal injuries, amputations, and fractures. In recent years, this perspective of caring for the individual has expanded into a broader public health perspective and the consequences for both companies and society in dealing with large numbers of 'minor' injuries and subsequent work absences (National Working Environment Authority [NWEA], 2005). This is partly motivated by increasing expenses

for companies and society, as well as demographic developments such as decreases in the workforce. If strategies are concerned with the primary prevention of injuries, then steps are taken to decide which types of injuries to target (e.g., fatal injury, sprains, strains, wounds, fractures, or amputations). Knowledge about prevention and the frequencies of different types of injuries as well as their effect upon the work would facilitate such decisions, particularly in high hazard industries.

Understanding the root causes of injuries is the beginning of enlightenment that can ultimately lead to the development of interventions that can be successfully implemented to curtail future injury occurrences (Hinze. J, Geneva Giang, 2008). This is a fundamental premise in accident prevention and is also evident from the mandated injury reporting requirements of employers. The Employer's First Report of Injury, a report commonly required by workers' compensation carriers in the U.S. for each injury (excluding first aid cases) that occurs, includes a section in which the employer is to describe the underlying cause of the injury. From this information, the employer can readily reflect on preventative measures that might be implemented. This information could be useful in implementing programs that would help prevent future injury occurrences. Studies of injuries in the construction industry are less common. Each year over 400,000 Occupational Safety and Health Administration (OSHA) recordable construction worker injuries are documented in the United States. Over 1,000 construction workers regularly die each year as a result of work-related accidents (National Safety Council). For 2004, the US Bureau of Labor Statistics (BLS) reported nonfatal occupational injury and illness incidence rates of 6.4 recordable cases per 100 full time construction workers, with 2.4/100 cases involving days away from work (BLS,

2004). Various studies have examined the details surrounding accidents in which construction workers were killed. Few have examined the information related to construction worker injuries as opposed to fatalities and this is a shortcoming that has been recognized on a global scale (Koehn et al., 1995) and (Suazo and Jaselskis, 1993). Despite the large number of injuries, several studies have demonstrated how estimates from the BLS and other sources underestimate the number and incidence of worker illnesses and injuries (Hunting et al., 1994; Glazner et al., 1998; Leigh et al., 2004). It is noted that under-reporting of injuries is most common for the less severe injuries. The examination of the possible contributors of injuries can help to make the workplace safer for the construction workers and this will ultimately improve the entire industry. In general, the studies that examined the root causes of serious construction injuries and fatalities were conducted by isolating the incidents that were related to one particular type of accident, e.g. falls, struck by, caught in/between, electrical shock and other (Hinze, 1996). The focus was not on the type of injury that was sustained by the injured worker, but rather on the initiating cause. This approach was used in most instances because of the serious nature of the injuries or because the accidents resulted in fatalities. This approach appears appropriate for serious injuries as preventative measures can be devised once patterns of accident causation are identified (Hinze, 1996).

Very few studies address the issue of minor injuries or first aid construction worker injuries on the construction job sites possibly because it is not mandated by OSHA to report these injuries. Emphasis is given only to injuries that are required to be reported by OSHA as recordable injuries. It is imperative to know that the causes of minor or first

aid injuries can lead to more severe injuries. Prevention of the causes of first aid injuries can lead to the prevention of more serious injuries.

First Aid Injuries

The first aid Injuries as per Occupational Safety and Health Administration (OSHA) are those injuries which that are usually administered immediately after the injury occurs and at the location where it occurred. It often consists of a one-time, short-term treatment and requires little technology or training to administer. According to the OSHA regulations and from OSHA Forms for recording work related injuries and illnesses, an injury is considered to be as a first aid injury and does not need to be recorded if it undergoes any of the following treatments:

- Using non-prescription medications at nonprescription strength
- Administering tetanus immunizations
- Cleaning, flushing, or soaking wounds on the skin surface
- Using wound coverings, such as bandages, Band Aids, gauze pads, etc.
- Using hot or cold therapy
- Using any totally non-rigid means of support, such as elastic bandages, wraps, non-rigid back belts, etc
- Using temporary immobilization devices while transporting an accident victim (splints, slings, neck collars, or back boards)
- Drilling a fingernail or toenail to relieve pressure, or draining fluids from blisters
- Using eye patches
- Using simple irrigation or a cotton swab to remove foreign bodies not embedded in or adhered to the eye
- Using irrigation, tweezers, cotton swab or other simple means to remove splinters or foreign material from areas other than the eye;
- Using finger guards

- Using massages
- Drinking fluids to relieve heat stress

These definitions or description indicate when injuries are not required to be recorded by OSHA. By not recording these first aid injuries, a wealth of information is generally not being monitored. In one study of over 100,000,000 worker hours of exposure it was discovered that there were approximately 30 first aid injuries each recordable injury (Huang and Hinze, 2006). Focus on the cause of first aid injury would provide a much richer source of information that could be helpful in developing means of accident prevention.

CHAPTER 3 METHODOLOGY

The objective of this study was to develop a construction worker first aid injury data recording tool and to analyze existing data to generate statistics regarding the factors associated with the injuries. Typically, construction firms do not record the first aid injuries, as they are not required to be reported as per Occupational Safety and Health Administration (OSHA) regulations. As a result information regarding factors related to the first aid construction worker injuries such as causation, nature and mechanism of injury, is lost. This information could be useful in preventing the first aid construction worker injuries in the future and it could further prevent more serious injuries.

This research began with a review of the literature concerning the more serious OSHA recordable injuries. This was done because virtually no articles were found concerning first aid construction worker injuries. While most construction firms do not record first aid injuries, it was noted through past research (Huang and Hinze, 2006) that larger projects were more inclined to record first aid injuries. An important aspect of this research was to collect actual first aid data that had been collected on construction sites. Contacts were made with corporate level safety personal at several large firms. They were asked if they recorded first aid injuries and, if so, could this information be provided for research effort. Ultimately, three construction firms agreed to provide the first aid information for further study.

The first id logs of the three firms were provided in MS Excel format. One of the logs was provided by a large general contractor, one by a specialty contractor and one by a facility owner. Each of the three logs that were provided contained about 1000

entries. These logs were compared to identify the type of information that was captured in the logs. While the firms that provided the logs were different in the type of projects undertaken, etc., the information in the logs was very consistent.

After the three first aid logs were examined, it was decided to utilize the data provided by the general contractor. This first aid log contained information on 1258 injuries and these included both first aid and recordable injuries. The initial extent of the research was to develop an Excel spreadsheet that would analyze and display data. Because of limitations in Excel, it was subsequently decided to utilize MS Access which was able to readily manage the data.

The software used for analyzing the data was carefully selected. The intent was to select software which was readily available, economical and easy to use. The software was selected on the basis of the ease with which the tool could be created. It was preferred that the software had low maintenance by a third party. Software that is available included FoxPro and FilePro which are useful in managing databases. Unfortunately, these software programs are costly and require maintenance by a software engineer.

Microsoft Excel was initially tried for the purpose of recording and analyzing the data. Excel proved to be very easy to use and economical. It was easily available as a part of the Microsoft Office Suite. It was discovered that Excel could record the data. A shortcoming was recognized in that Excel required appreciable amount of macros coding for it to be used as a fully functional database. This was not desirable from the ease of use point of view. Also, the database made by using Excel was found to be easily vulnerable to accidental changes. The extraction of data proved to be difficult

since it required coding. To make the process of generating a statistical representation easy, Sigmaplot, software that could interact with Excel, had to be used. Excel data could be exported into Sigmaplot to generate statistics with respect to the data set being analyzed. This proved to be excessively cumbersome, since Sigmaplot is not readily available and ready to use. Also, Sigmaplot requires inputs in terms of numericals. This would make it difficult to interpret the report generated, since the assigned numbers would have to be referred back and forth. Thus, Excel along with Sigmaplot proved ineffective to achieve the required goal.

After exploring the options for feasible software, Microsoft Access 2010 was examined as a tool for performing the data storage and retrieval functions. Access contains built-in functions which facilitate the easy input and extraction of data. The data containing 1258 injury entries was sorted to make the result from analysis uniform in terms of interpretation. The data set was obtained in an excel sheet. Entering the data one by one would be a tedious job, hence, the import function in Access 2010 was used to import the data from the Excel file to a newly created Access database file. The columns of the Access data sheet were customized as per requirements in terms of date, time and text field to ensure the correct formatting of the data entered. A form was also created using the form function to facilitate the data input in future. Different queries based on the needs for analyzing the data were created to extract the data from the database file. Analysis was done based on the extracted data. The query was exported into Excel for creating graphical representation since Access does not create graph. The query was modified to obtain different datasets narrowed based on the

factors that were desired to be analyzed. Data contained in the log after identifying them and sorting the injuries consisted of the following categories:

1. Name
2. Case number
3. Date
4. Type of injury
5. Nature of injury
6. Cause of injury
7. Body part injured
8. OSHA recordable (Yes/No)
9. Type of Injury
10. Month
11. Day
12. Time

Reports were created to summarize the first aid construction injury data. Reports gave an overall view of information concerning the injuries. Reports were customized and created to tabulate the number of entries of each factor associated with the first aid construction workers injuries. The report extracts data from the database and gives the exact total number of instances of injuries. The report gives the number of injuries and the percentages with respect to the total injury occurrences. Information specific to the factors associated with the injuries was summarized. For example, a report can be created to give the total number of injuries that occurred in the individual months of the year or the total number of hand injuries, etc. Reports can be customized to convey the desired information. The analysis of the data obtained gave an insight into the first aid injuries construction worker injuries on a construction site with respect to the number of injuries and factors affecting the injuries.

CHAPTER 4 MICROSOFT ACCESS

Microsoft Access is used to create simple database solutions. Access tables support a variety of standard field types. Access also includes a query interface, forms to display and enter data, and reports for printing. Microsoft Access is very popular among non-programmers who can create visually pleasing and relatively advanced solutions without in depth knowledge of coding programming language. It is also easy to place a database on a network and have multiple users share and update data without overwriting each other's work. Data is locked at the record level which is significantly different from Excel, which locks the entire spreadsheet.

Access offers a wide range of template databases within the program and for download from their website. These options are available upon starting Access and allow users to quickly use and enhance a database with pre-defined tables, queries, forms, reports, and macros. Templates do not include VBA code. Users can create tables, queries, forms and reports, and connect them together with macros. Advanced users can use VBA to write rich solutions with advanced data manipulation and user control.

For query development, Access offers a "Query Designer", a graphical user interface that allows users to build queries without knowledge of the SQL programming language. In the Query Designer, users can "show" the data sources of the query (which can be tables or queries) and select the fields they want returned by clicking and dragging them into the grid. One can set up joins by clicking and dragging fields in tables to fields in other tables. Access allows users to view and manipulate the SQL

code if desired. Any Access table, including linked tables from different data sources, can be used in a query.

Reports can be generated to give an overview of the data queried in a particular format to suit the needs of the user or the audience. The report can be easily designed using the report wizard. More complex reports which make calculation before producing a result can be created using a small extent of coding.

Creating the Database

The database created in Microsoft Access 2010 would be the storage space which would hold all the construction site injury details. The required injury details can be entered into or extracted from this database to have an overview of the injuries. Following are the steps we follow to create the database.

Creating a File

A Microsoft Access 2010 files needs to be generated. Microsoft Access can acquired using Microsoft Office 2010 at no additional cost. It is found under the following path:

Start>All Programs>Microsoft Office>Microsoft Access 2010

A click on the Microsoft Access 2010 tab will open a new file. On the File tab, click New, and then click Blank Database. In the right pane, under Blank Database, type a file name say 'FirstAidInjury', in the File Namebox. To change the location of the file from the default, click Browse for a location to put your database (next to the File Name box), browse to the new location, and then click OK and then Click Create. Figure 3-1 shows the layout of an Access start up screen.

Creating Tables and Columns

Access creates the database with an empty table named Table1, and then opens Table1 in Datasheet view. The cursor is placed in the first empty cell in the Click to Add column. Since we want to create a database for recording construction site injuries, we will create and modify the tables and columns inside the tables as per user requirements. The table 1 created by access by default can be deleted. On the Create tab, in the Tables group, click Table Design. For each field in the Table, type a name in the Field Name column, and then select a data type from the Data Type list. If you want, you can type a description for each field in the Description column. The description is then displayed on the status bar when the cursor is located in that field in Datasheet view. The description is also used as the status bar text for any controls in a form or report that you create by dragging the field from the Field List pane, and for any controls that are created for that field when you use the Form Wizard or Report Wizard. After all of fields have been added, save the table by clicking Save on the File tab and in name the table 'Injury Details'. Data can be typed in the table at any time by switching to Datasheet view and clicking in the first empty cell. Figure 3-2 shows the procedure of creating and formatting a table.

Based on the requirements for First Aid Injury recording model, we enter the columns names such that it reflects the type of data that is being recorded, like, nature of injury, cause of injury, day of injury, time of injury and so on. In figure 3-3, an access database file with details entered in the formatted columns can be seen.

Creating Form for Data Input

A form is a database object that you can use to create a user interface for a database application. A form is one that is directly connected to a data source such as a table or query, and can be used to enter, edit, or display data from that data source. Forms can be used to control access to data, such as which fields or rows of data are displayed. For example, certain users might need to see only several fields in a table with many fields. Providing those users with a form that contains only those fields makes it easier for them to use the database. Command buttons can also be added and other features to a form to automate frequently performed actions. Forms are windows through which people see and reach your database. An effective form speeds the use of the database. Figure 3-4 shows an overview of the form wizard.

To create a form for entering data in access, click on the 'Create' tab and then on the 'Form Wizard'. The form wizard will pop up and under the heading 'Tables/Queries', the wizard will show the existing tables made, in this case the table Injury Details. Since, the fields in the table were created as required; all need to be selected for making the form. Next window prompts for selecting the layout of the form to be displayed. A column view is preferred in this case and then the form is named 'Injury Details Form' and then saved. Once finished, the form opens up which allows the user to enter the data. It should be noted that the form is in design view. It has to be turned to form view for data to be entered. The form design and layout can be modified using the design view and the formatting option under the properties tab. Figure 3-5 shows a completed form which allows entering data in an access file.

Creating a Drop Down List

It is convenient to have a drop down list on the form from which a user can select the applicable data to be entered. Due to the drop down list, the user would not be able to type any value using the keyboard in the form fields which will help in keeping the data consistent and facilitate the easy retrieval of information required from the database.

For creating a drop down list, first a table has to be created with columns containing the required data a user desires as a drop down list when filling out a form. Figure 3-6 shows an example of the table which contains the details that may be required to be selected from a drop down menu to be entered in a database. The drop down list has to be created when making the form. When creating the form, click on the design tab and options for tools to be used for the form pops up. Chose the tool for making a combo box and the wizard for combo box will prompt for the steps to make and link the combo box to enter data. The combo box needs to intake the data from the table created containing the list of details under different columns.

Adding Buttons

The design tool gives an option of adding command buttons to the form. The button needs to be selected and appropriate function needs to be assigned using the wizard. The functions assigned are usually the ones associated with creating a form like add new record, save records, delete record, and close form and so on.

This concludes the making of the database to input and save the details of the construction site injury. Now the query function needs to be generated so that required data can be extracted from the injury records.

Generating a Query

A query allows the user to extract data from the database. The user can query the database as per requirement to pull out specific information and have an overview of the records. The data can be extracted based on a single field or based on multiple fields. To create a query, go to the create tab and click on the query wizard. The query wizard will prompt for the required steps. Figure 3-7 shows the query wizard and the various options it contains.

The type of query to be generated has to be selected. A thumbnail view of different types of queries can be seen on the left side of the query wizard. The appropriate table from which the information needs to be extracted has to be selected and the required fields have to be inserted in the query. The query wizard after completion shows the view of the query in design mode. Figure 3-8 shows the query in the design mode.

The criteria field is where the required information desired should be entered. For example, as shown in the above picture, the information for carpenters with sprain is desired. After hitting the run tab the query will pull out all the information which will have carpenters with sprain and other details associated with them. Figure 3-9 shows a query which extracts information for the injuries of all carpenters with sprain as the nature of injury.

Another type of query which is useful to get the summary of the data is the cross tab query. The cross tab query gives the count of the specific fields desired and adds up and displays the total number of instances. A crosstab query can be chosen while using the query wizard as explained earlier for making a simple query. The row and column title are chosen as per needed. To get an exact count of the number of instances or say

number of injuries, the Id column of the database is chosen and the query is set to count the number of ids.

A crosstab query made for finding the number of injuries for the months of year and narrowing it down to the injuries for the days of week will give an overview of the number of injuries for a particular month and for a particular day of week within that month. Figure 3-10 shows a crosstab query which summarizes the information for injuries occurring in different months of the year and further classifies them according to the days of the week.

Creating Report

Reports are the end product of the database. Reports combine the facts in database with enough information to give those facts meaning, and they present the results visually. For example, if you need to use charts or graphs, you use a report. Reports are also the best way to format and print data, and they're a good way to summarize data. For example, you can group injuries by month and sort them by days of the week and calculate a subtotal for each group, as well as a grand total for all groups. Figure 3-11 shows a report generated to give number of injuries based on month of April, which was further narrowed down to the Friday in April and then further narrowed down to arm injuries. The report shows the injuries in number as well as in percentages of the total injuries. The report thus would list out all the incidents of injuries for the period it was generated for and give the overview in terms of numbers and percentages. The overview can be changed as desired using the group and sort tool under the design tab.

Graphical Representation

The query generated by Access can easily be exported to Excel and charts or graphs can be created in Excel to represent the data graphically for a presentation or a meeting, which would allow a better overview of the data. Figure 3-12 shows the exporting of the data to excel. It should be noted that the data can also be exported to another access file or word document.

This concludes the methodology of creating the database and generating views to analyze the data which includes steps from entering the data for recording it and then extracting the required details from the database. The database is easy to create and can be generated spontaneously on the construction site by a person with average computer literacy. The data entering method using a form is simple to use.

The idea behind making an injury database using Microsoft Access 2010 was to provide a readily available data recording tool for recording construction injuries which can be analyzed using Microsoft Access 2010 on the construction site itself to generate an overview of how the construction injuries look like in terms of their nature, causes, days of occurrences, time of occurrences and other such factors. To check how the database model operates and provides with desired output, First Aid Injury data from was used as a case study.

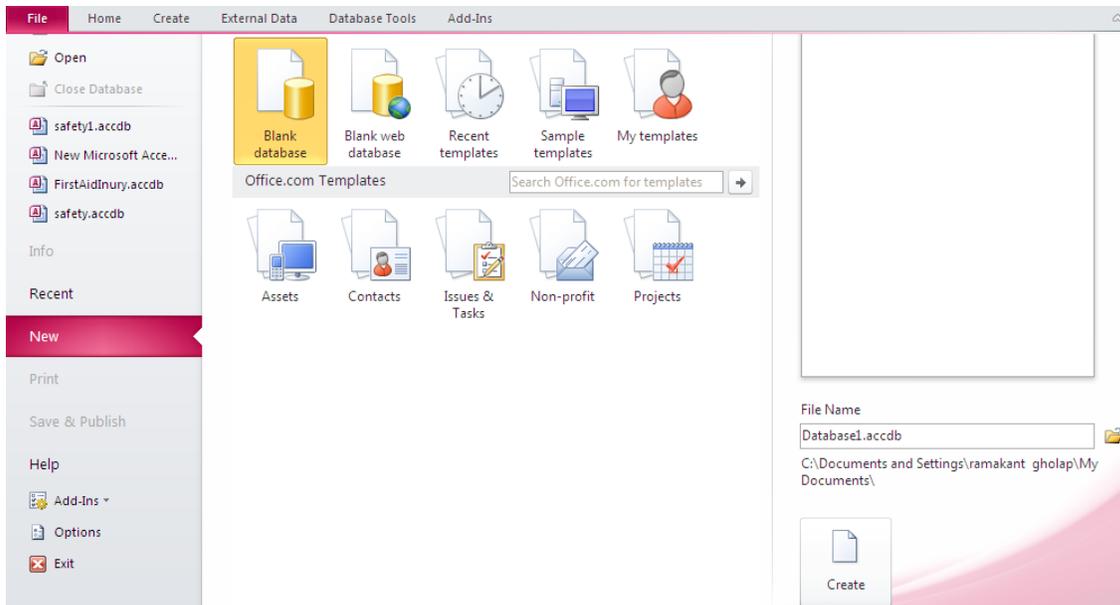


Figure 4-1. Creating a new file in Access 2010 for creating a new database

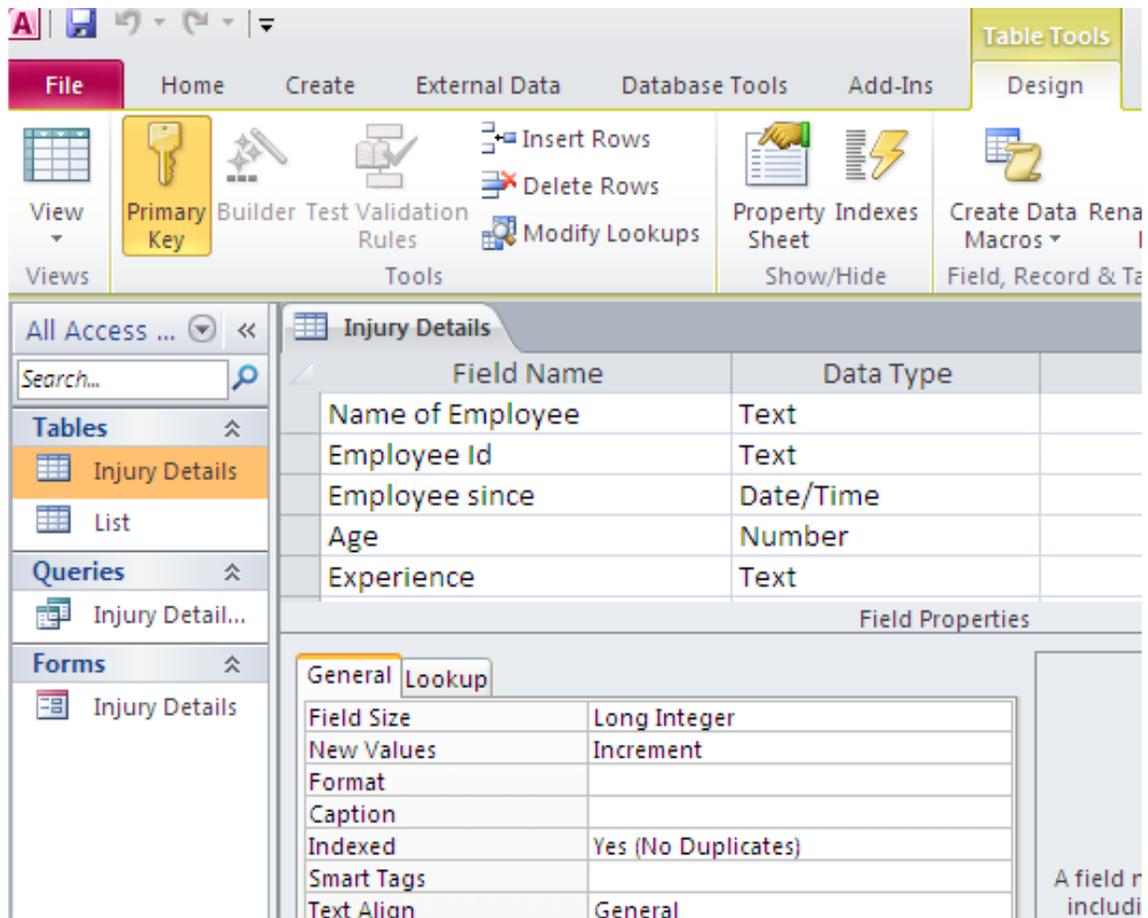


Figure 4-2. Creating new table and column for the database

Trade	Nature_of_Injury	Cause_of_Injury	Body_Part_Injured	OSHA_Recor	Date_occurr	Day	Time_occurr
Carpenter	Sprain	Struck by object	Shoulder	Yes	1/24/2007	Tuesday	13
Carpenter	Sprain	Body mechanics	Foot	No	1/3/2007	Wednesday	14
Laborer	Sprain	Slip, trip or fall	Back	Yes	1/3/2007	Wednesday	15
Carpenter	Contusion	Struck by object	Chin	Yes	1/4/2007	Thursday	13
Carpenter	Sprain	Slip, trip or fall	Ankle	Yes	1/5/2007	Friday	11
Cement Finisher	Insect bite	Other	Leg	Yes	1/5/2007	Friday	9
Carpenter	Puncture	Sharp or pointed object	Forearm	Yes	1/10/2007	Wednesday	10
Laborer	Contusion	Vehicle/Equipment	Back	Yes	1/11/2007	Thursday	8
Laborer	Contusion	Struck by object	Leg	No	1/11/2007	Thursday	16
Carpenter	Sprain	Sharp or pointed object	Neck, Back	No	1/11/2007	Thursday	18
Carpenter	Sprain	Body mechanics	Back	No	1/16/2007	Tuesday	17
Laborer	Foreign body	Inadequate eye protection	Eye	No	1/17/2007	Wednesday	16
Carpenter	Sprain	Slip, trip or fall	Wrist	No	1/17/2007	Wednesday	19
Cement Finisher	Foreign body	Struck by object	Eye	No	1/18/2007	Thursday	16
Carpenter	Sprain	Body mechanics	Back	No	1/18/2007	Thursday	17
Service Mechanic	Sprain	Vehicle/Equipment	Neck	No	1/19/2007	Friday	11
Laborer	Contusion	Struck by object	Shoulder	No	1/24/2007	Wednesday	12

Figure 4-3. Over view of an Access table with columns formatted and data entered

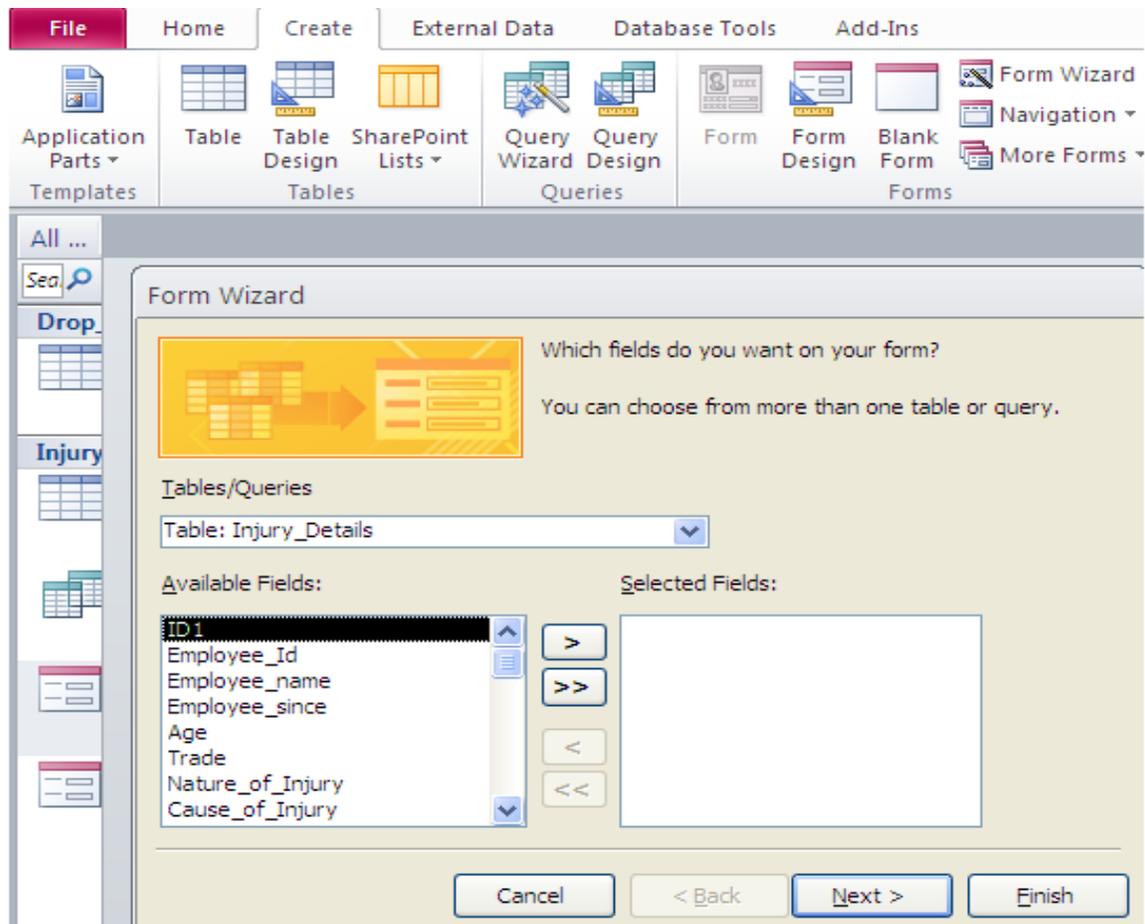


Figure 4-4. Form Wizard to design form for data input

The form is titled 'Injury Details' and contains the following fields:

- Name of Employee
- Employee Id
- Employee since
- Age
- Experience
- Trade (dropdown)
- Nature of Injury (dropdown)
- Mechanism of Injury (dropdown)
- Body Part Injured (dropdown)
- OSHA Recordable (dropdown)
- Type of Injury (dropdown)
- Date occurred
- Time (dropdown)
- Day (dropdown)
- Month (dropdown)

Figure 4-5. Form for data input with embedded blank fields and drop down menu option

The table 'List' contains the following data:

ID	Trade	Nature of In	Mechanism	Body Part In	OSHA Recon	Tye of Injury
1	Business Devel	Abrasion	Body Mechanic	Abdomen	Yes	Fatal
2	Carpentari	Amputation	Chemical	Arm	No	First Aid
3	Cement Finish	Burn	Electric Shock	Ankle		Hospitalised
4	Cement Maser	Chemical Inges	Excessive Tem	Back		Non-Job Relat
5	Concrete Finis	Contusion	Inadequate Eye	Chin		Medical Treat
6	Co-op	Dislocation	Heat	Ear		
7	Electrician	Electric Shock	Noise	Elbow		
8	Engineer	Foreign Body	Other	Eye		
9	Foreman	Fracture	Repetitive Mot	Face		
10	Formsetter	Hernia	Sharp Pointed	Knee		
11	Helper	Insect Bite	Slip, Trip, Fall	Head		
12	Human Resour	Laceration	Struck By Objec	Hip		
13	Ironworker	Puncture	Tool	Leg		
14	Laborer	Sprain	Vehicle/Equip	Pelvis		
15	Manager			Shoulder		
16	Mechanic			Wrist		
17	Operator					

Figure 4-6. Table generated for fields to be embedded in drop down menu for selection during data input

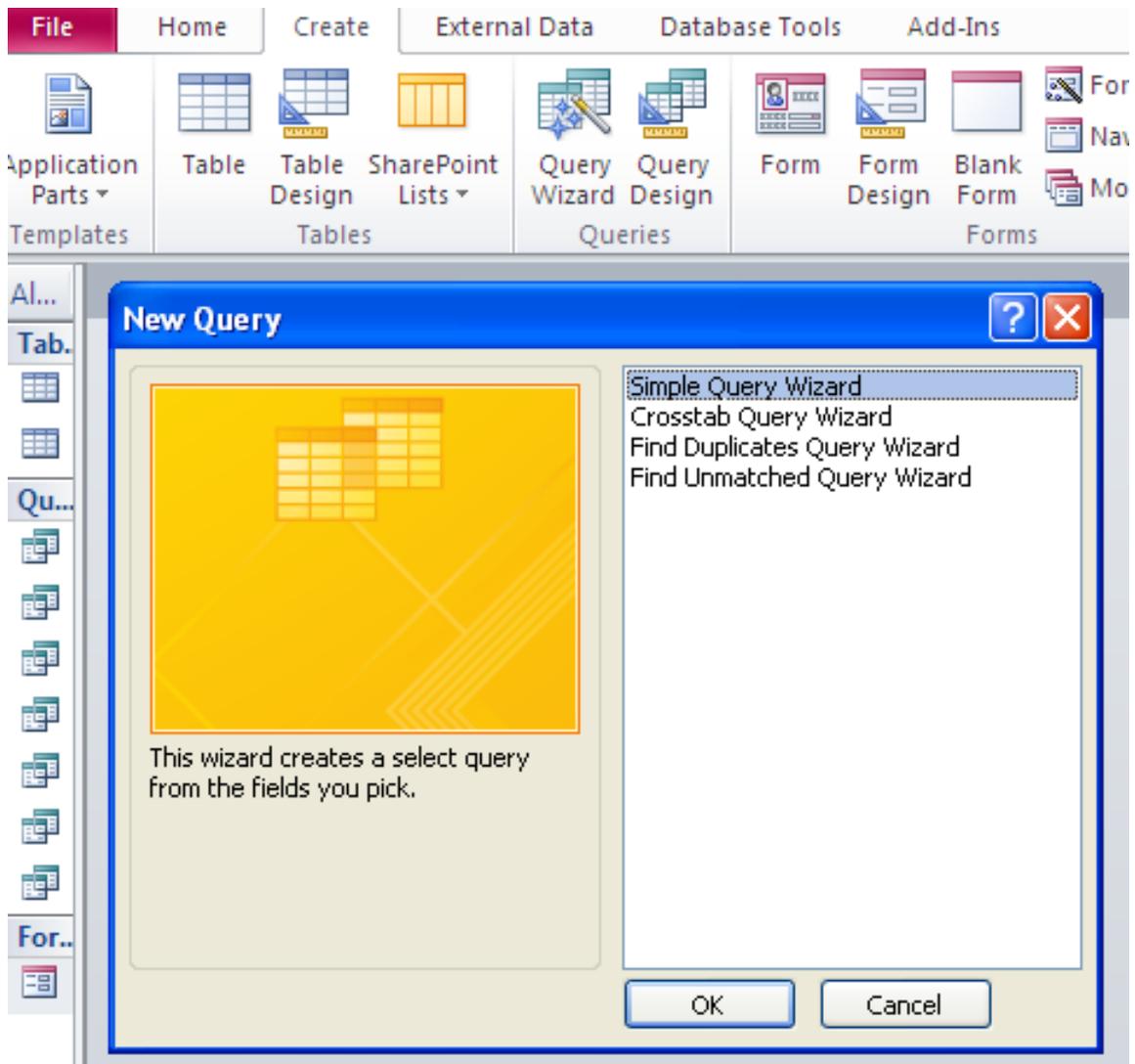


Figure 4-7. Wizard for generating need based simple query

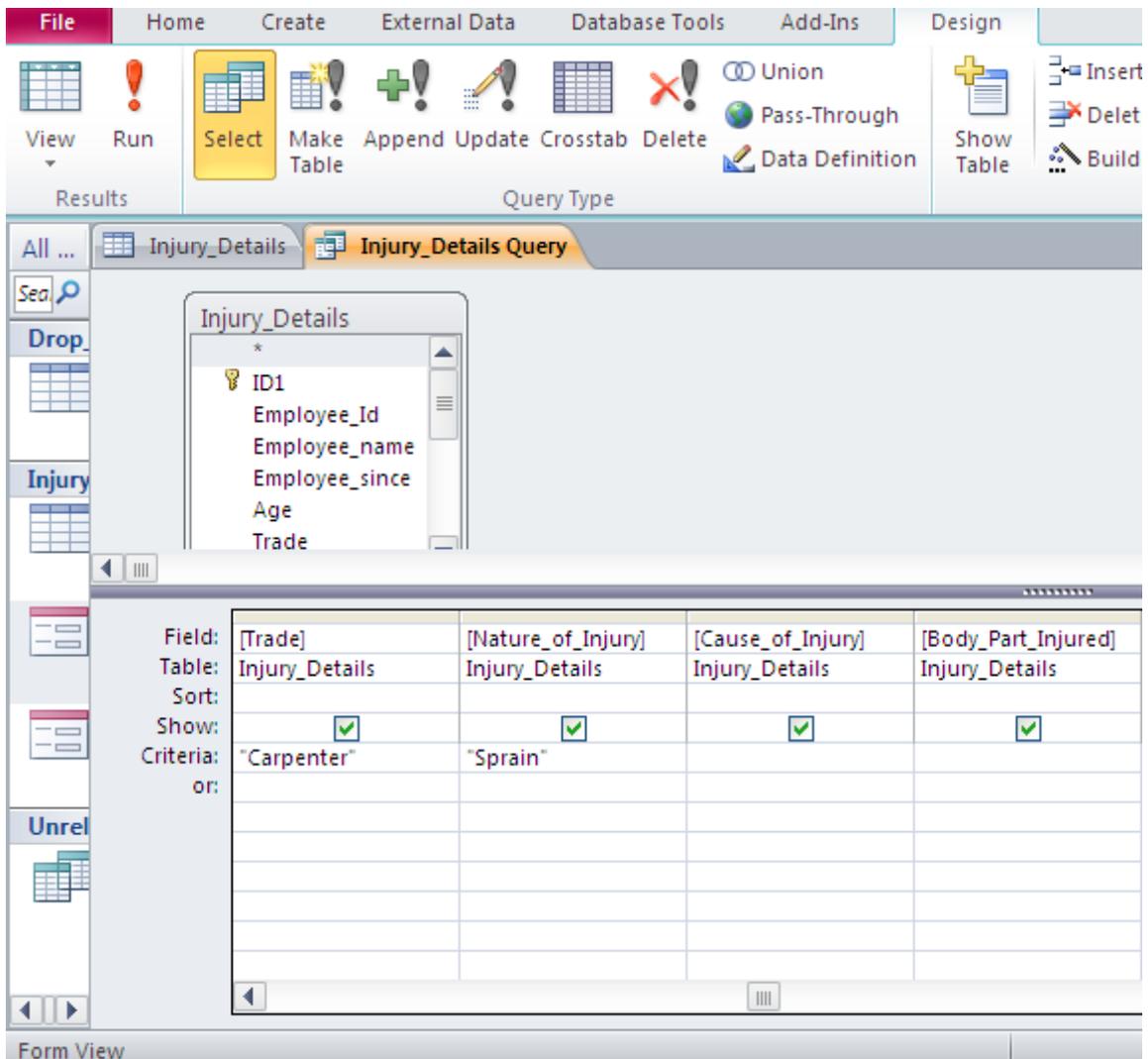


Figure 4-8. Layout of a query with selected fields and desired output information

safety : Database (Access 2007) - Microsoft Ac

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View Paste Copy Format Painter Filter Ascending Descending Remove Sort Toggle Filter Selection Advanced Refresh All Delete More

Injury_Details Injury_Details Query

Trade	Nature_of_Injury	Cause_of_Injury	Body_Part_Injured
Carpenter	Sprain	Sharp or pointed object	Neck, Back
Carpenter	Sprain	Body mechanics	Back
Carpenter	Sprain	Slip, trip or fall	Wrist
Carpenter	Sprain	Body mechanics	Back
Carpenter	Sprain	Slip, trip or fall	Hand
Carpenter	Sprain	Slip, trip or fall	Groin
Carpenter	Sprain	Slip, trip or fall	Foot
Carpenter	Sprain	Struck by object	Shoulder
Carpenter	Sprain	Body mechanics	Back
Carpenter	Sprain	Body mechanics	Back
Carpenter	Sprain	Body mechanics	Back
Carpenter	Sprain	Slip, trip or fall	Ankle
Carpenter	Sprain	Slip, trip or fall	Leg
Carpenter	Sprain	Repetitive motion	Back
Carpenter	Sprain	Slip, trip or fall	Shoulder
Carpenter	Sprain	Body mechanics	Forearm
Carpenter	Sprain	Body mechanics	Back

Figure 4-9. Output of a query based on two desired fields of trade and nature of injury

Month Based						
Month	Total Of Em	Monday	Tuesday	Wednesday	Thursday	Friday
April	11		1	3	2	4
August	12	2		2	1	2
December	10	2	1		5	2
February	11	3		3	1	1
January	11		3	1	1	5
July	11		2	1	2	3
June	11	2	1		3	3
March	11	1	3		4	1
May	11	1		1	3	2
November	11	2		2	2	2
October	11		2	2	2	4
September	11	2	2		4	1

Figure 4-10. Output of a crosstab query giving summary of number of injuries based on months of the year and days of the week

IncidentListing		
April	97	7.71%
Friday	7	0.56%
Arm	2	0.16%
Cause_of_Injury	Repetitive Motion	
Nature_of_Injury	Sprain/Strain	
Trade	Non-Manual	
Cause_of_Injury	Insect Bite	
Nature_of_Injury	Insect Bite	

Figure 4-11. Report generated extracting injury number based on month, day and then body part injured giving numbers and percentages with respect to total number of injuries recorded and stored in the database

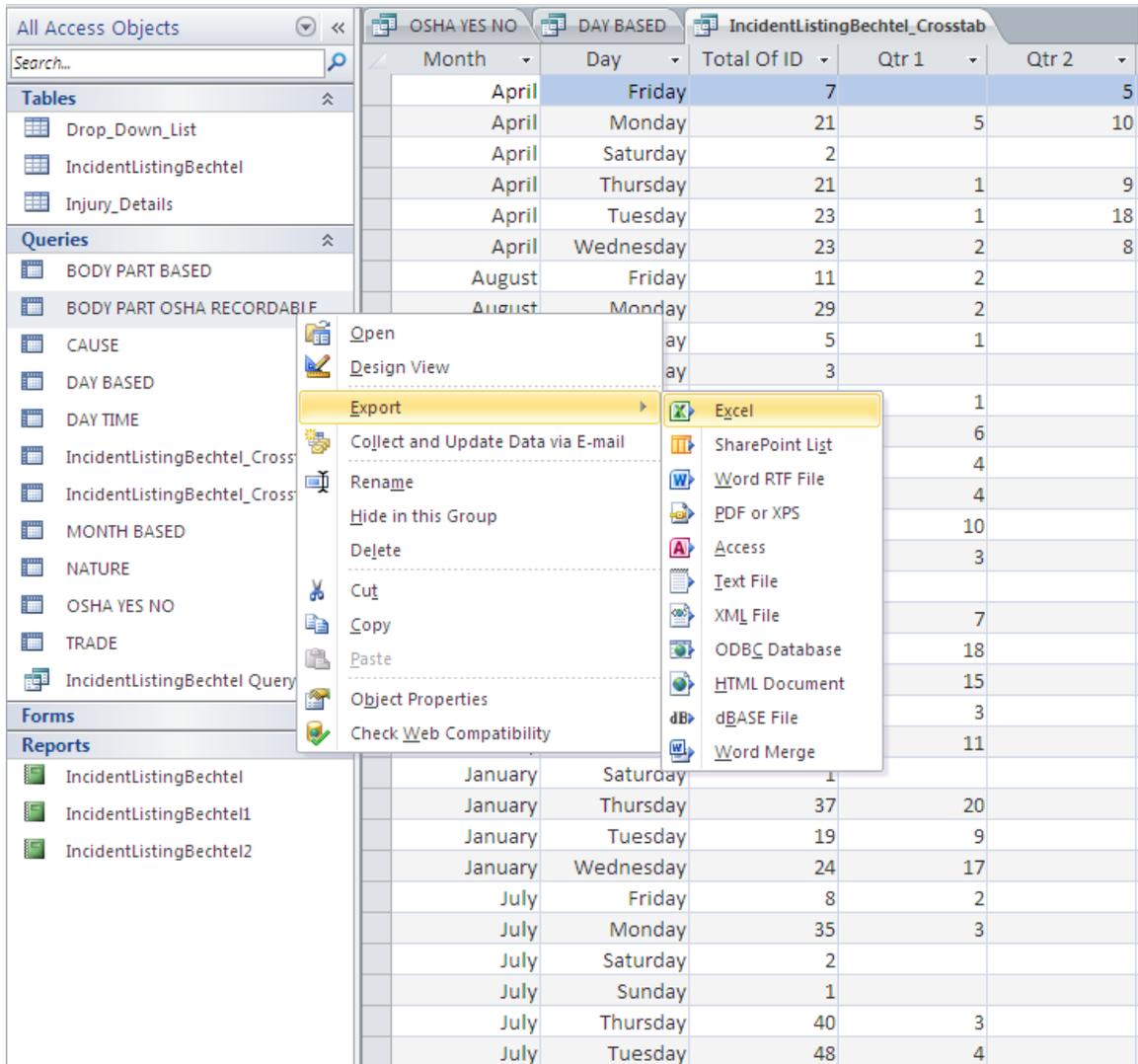


Figure 4-12. Steps for exporting the data in Excel for making graphs

CHAPTER 5 CASE STUDY: ANALYSIS OF FIRST AID INJURY DATA

The efficient operation of the database was tested by using the first aid injury data obtained from three major construction firms. A data base was created using the details obtained from the firms and the first aid Injury data from was stored in the database for analysis and generating a required query and report to get an over view of the injuries. The data contained 1258 entries of the onsite first aid injuries. The data contained details such as date of injury, day, month, cause of injury, nature of injury, body part injured, trade of the worker injured, Occupational Safety and Health Administration (OSHA) recordable or not and so on. The injury data were queried and analyzed based on the output produced by the query. Following are the categories by which the first aid construction worker injury data was classified:

Based on Body Part Injured

The data were queried to generate the output for the distribution number of the injuries for different body parts and whether the injuries were OSHA recordable or not. Table 4-1 shows eighteen different body parts and a total of 1258 body part injuries. Figure 4-1 shows a graphical representation of the extent to which each body part was injured. It is observed that hands suffered most of the injuries followed by the back, leg and arm injuries. This conveys that there may not be adequate protective measures or appropriate personal protective equipment (PPE) used to protect these particular body parts. The injuries may also mean that the nature of work makes these parts most vulnerable to injuries.

Based on Day of the Week and Time

The database was queried to give the total number of injuries on a particular day of the week and for a particular time of the day. Table 4-2 shows how the 24 hours in a day were divided into four quarters to make it simple to understand the distribution of injuries by time of the day. It was observed that the number of injuries were maximum on Monday followed by Tuesday, Wednesday and Thursday. There was little difference between the injuries on these days but the number of injuries differed significantly on Fridays. Fewer injuries occurred on Saturday and Sunday presumably because of the fact that these are weekends and work is rarely carried out on weekends. The number of injuries on a weekday have been the maximum in the last quarter (6pm to 12am) followed by the first quarter (12am to 6am). The second quarter (6am to 12pm) and the third quarter (12pm to 6pm) have almost the same number of injuries. The working conditions, nature of work, and the lighting conditions for the work done after sunset should be examined to avoid these injuries. Working in poor weather conditions may alter influence the incidences of injuries. Figure 4-2 shows the graphical representation of the number of injuries on a particular day along with the time zone in which they occurred. The number of OSHA recordable injuries is 322 which convey that these injuries have been serious enough to be OSHA reportable. The non-recordable 936 injuries may be non-serious as per OSHA standards. These injuries typically are treated on site and do not require a day off from work.

Based on Months

The database was queried to extract the number of injuries by the months of the year. This query provided information on the number of injuries by month. These injuries can be associated with the work environment during different months of the year. For

example, extreme hot weather can be experienced during the months of May and June while very cold weather conditions can be faced by the workers during the winter months of January and February. Heavy rains can also make the construction operations on the site difficult to be carried out. The weather conditions in a particular month may also be dependent on the location of the construction site in different parts of the country. Precautions can be taken to overcome the extreme weather conditions like heat, cold or rain.

Figure 4-3 shows the injuries that were recorded during different months of the year. It was observed from the injury data and its analysis that the highest number of the injuries were in the month of July. The months of June, August and September also had significant numbers of injuries, with November having the least injuries. The injuries may be associated with the weather conditions. The other factors for the varying number of injuries maybe due to the amount and type of work being carried out at various stages of the project. The number of injuries would presumably rise with the amount of work being carried out and decline when the project is at it starting stage or at its closure.

Based on Cause of Injury

The cause of injury tells how the worker was injured. The causes due to which the workers are injured can be examined and applicable measures can be taken to overcome those reasons. The analysis of the causes provides the distribution of the varying causes of injuries. This may convey information about whether the cause of injuries is related to the method by which the work was being done or if it was the conditions under which the work was carried out. Other reasons may include factors

such as inappropriate use of PPE or weather conditions. Table 4-3 shows the breakdown of the causes of injuries.

The data were graphically represented to show the distribution of injuries based on the causes. In figure 4-4, it is evident that the maximum number of injuries occurred due to workers being struck by objects. Struck by incidents include workers ignoring the objects such as machinery or tools on the construction site and not taking precautionary measures to avoid them or dropping them. Workers need to co-ordinate with each other to avoid hitting others or getting hit by others with the tools and machinery used on construction sites.

The other major leading causes for injuries were body mechanics, slip/trip/fall and repetitive motion. Care should be taken to avoid tripping and falling on construction sites since there may be potentially dangerous objects a worker can fall onto. The method of performing a manual job should also be corrected to avoid injury due to body mechanics and repetitive motion.

Based on Nature of Injuries

The nature of injuries gives information about the effect of the injury on the construction worker as shown in Table 4-4. This information can help in determining what treatment should be given to the injured workers. The nature of the injuries can also help in determining what preventive measures should be taken to avoid the reoccurrence of certain types of injuries. Based on the number of injuries of a particular nature, measures can be devised to avoid the injuries.

Figure 4-5 shows that most injuries were strains or sprains followed by contusions, lacerations and abrasions. From the nature of these injuries it is evident that measures should be implemented to reduce the stresses on workers' that cause sprains or strains.

Adequate Personal Protective Equipment (PPE) should be provided to avoid injuries such as contusions, abrasions and lacerations.

Based on Trade

The database was queried to extract information for number of injuries based on the trades of the injured workers. Table 4-5 shows the query for the injury data based on the trade of workers. This shows that certain trades are more vulnerable to certain injuries. From this inferences can be made about the types of injuries associated with particular tasks.

Change can be made on how particular trades are being executed to avoid injuries. Figure 4-6, shows that the most injury prone trade from the injury data is that of the laborers, carpenters and the non-manual workers. These are followed by the electricians, ironworkers, pipefitters and the rebar workers. Investigation into the tasks performed by these trades could lead to the particular approach to avoid certain construction injuries.

The database created for recording and analyzing the First Aid injury data can be used readily on any construction site. The injuries can be recorded and information can be extracted as required. The steps explained in the previous chapter can be modified to create a database to suit the needs of a particular construction site.

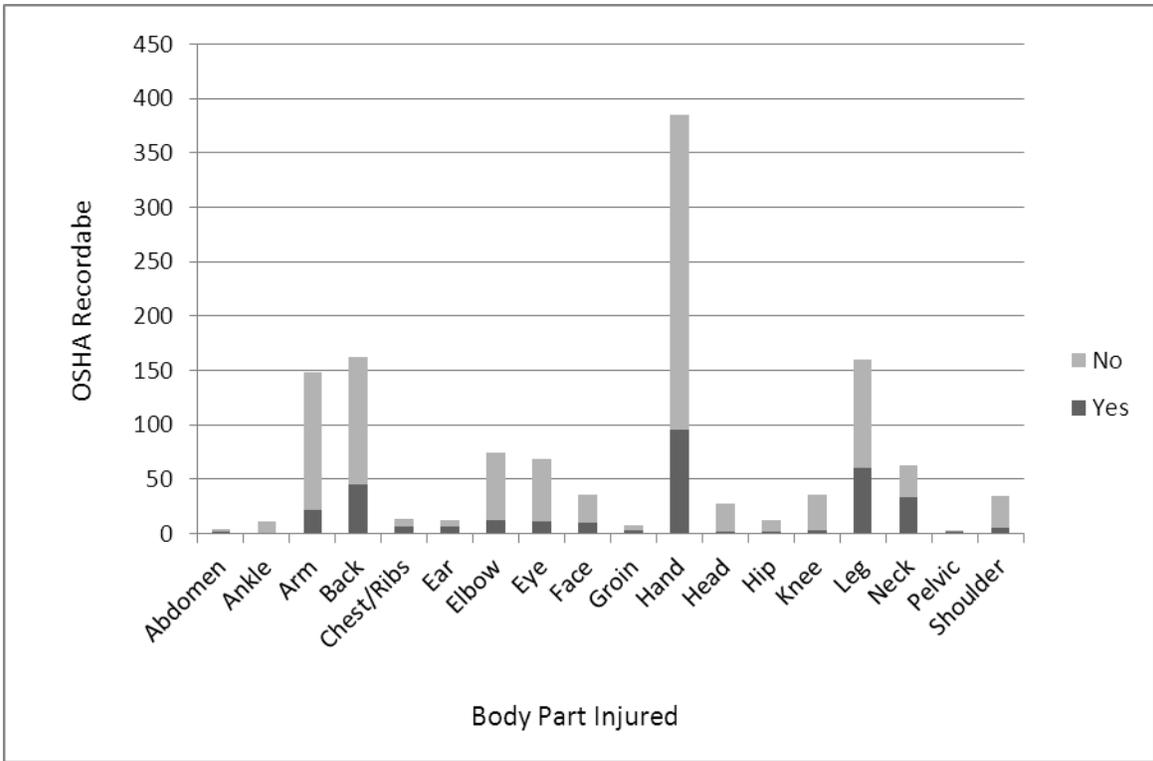


Figure 5-1. Body part injured v/s OSHA recordable criteria

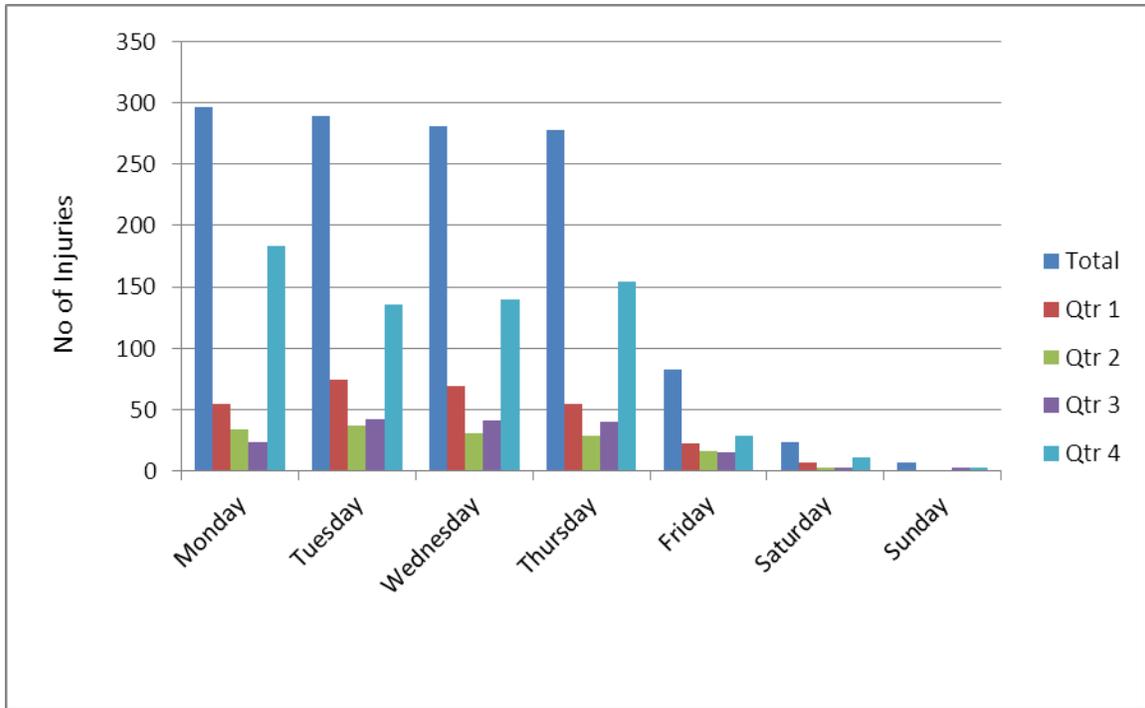


Figure 5-2. Number of injuries based on days of week and time of day

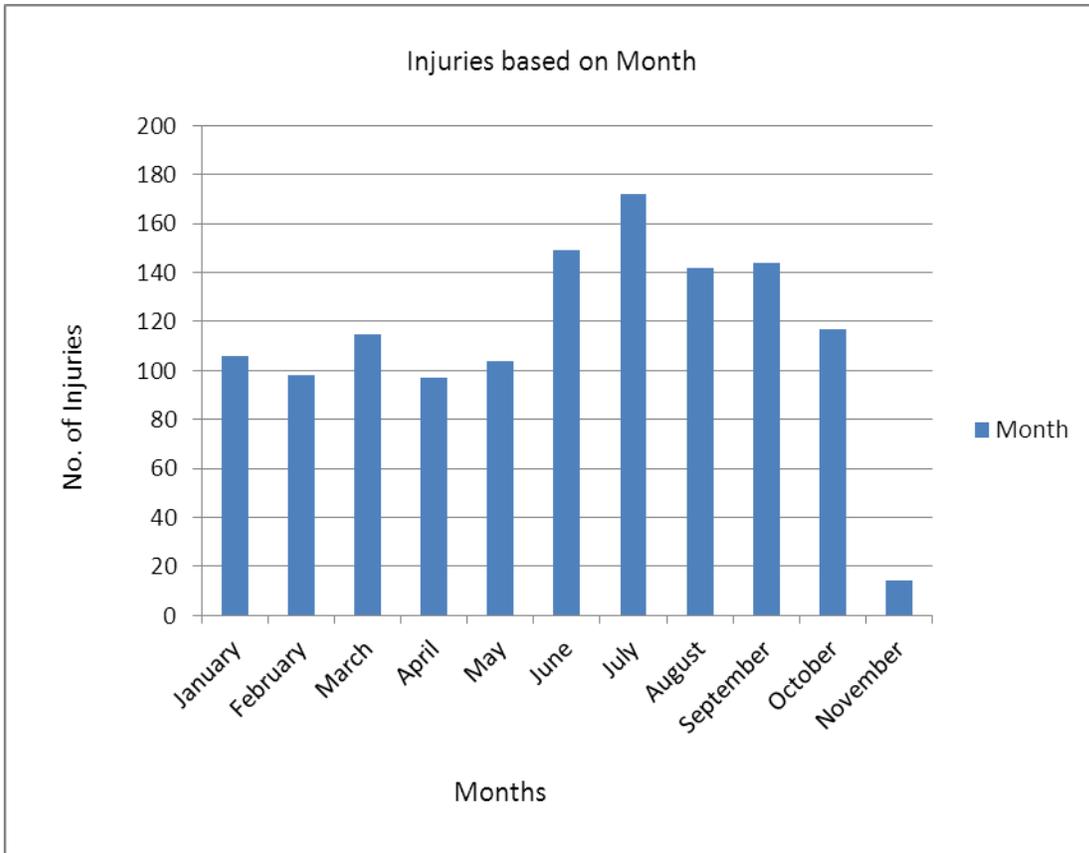


Figure 5-3. Numberof injuries based on months of the year

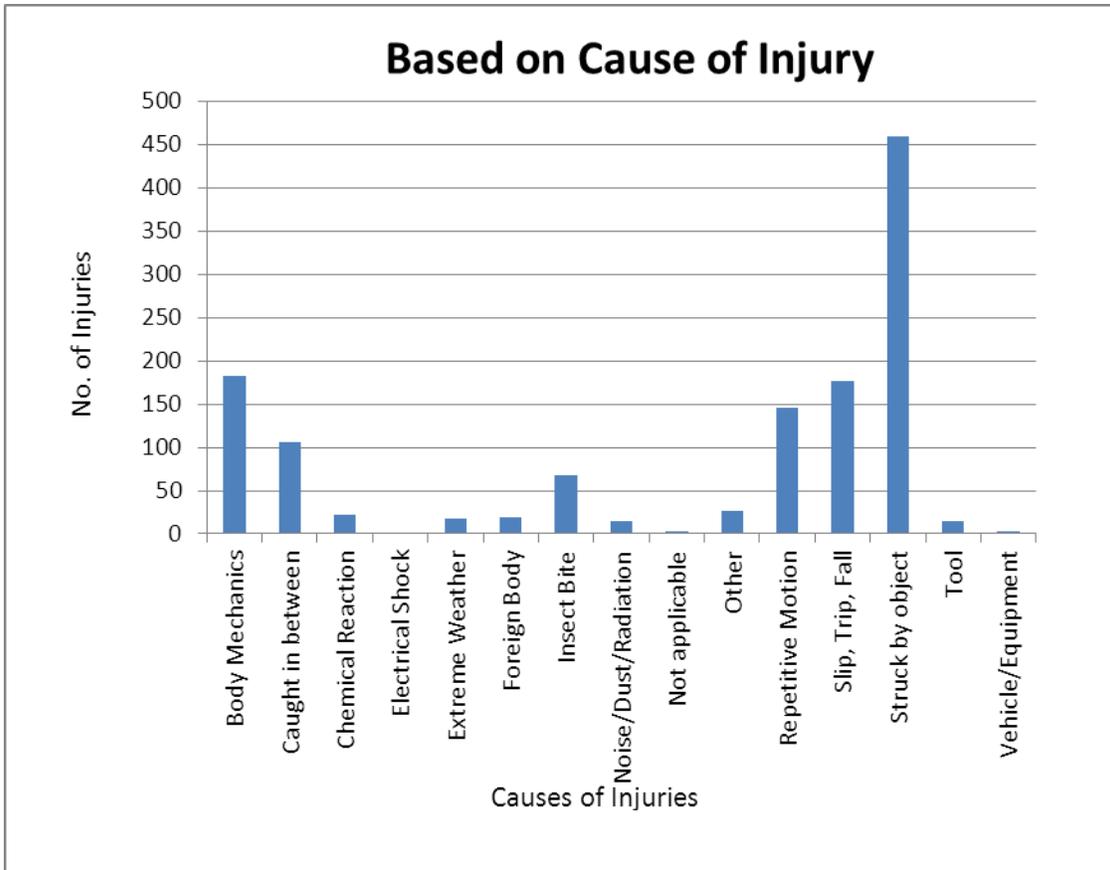


Figure 5-4. Number of injuries for specific causes of injuries.

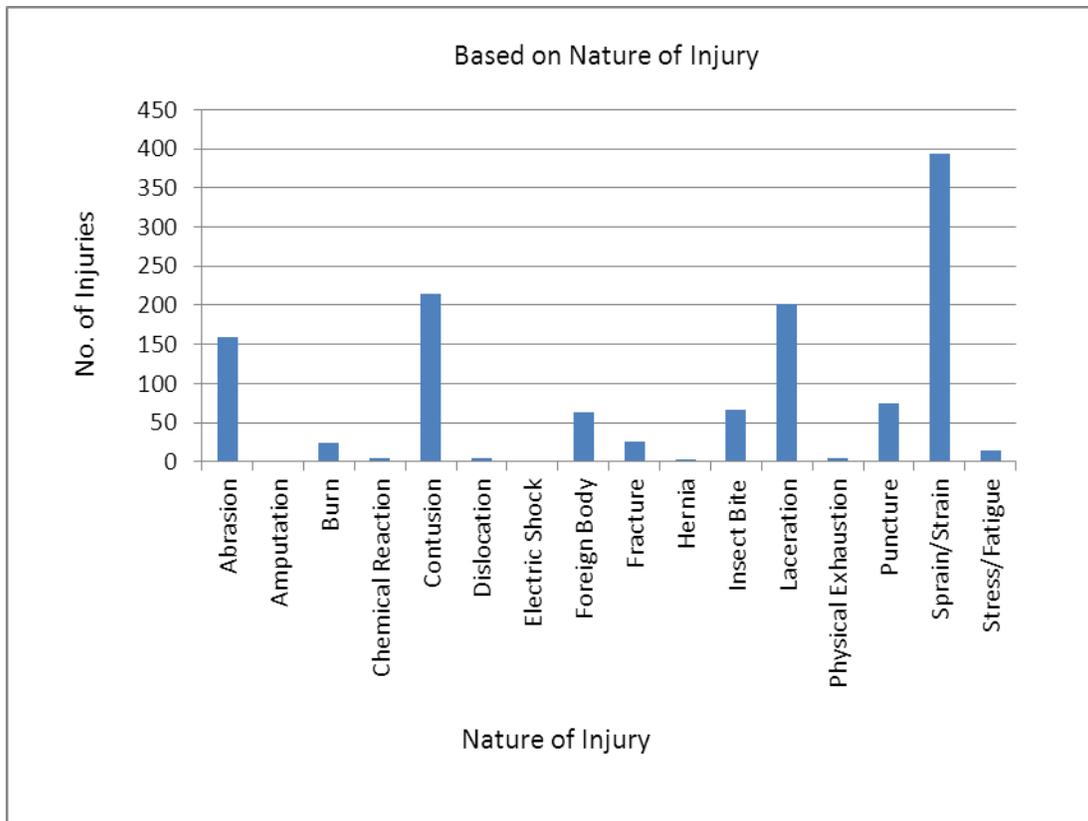


Figure 5-5. Total injuries for different natures of injuries

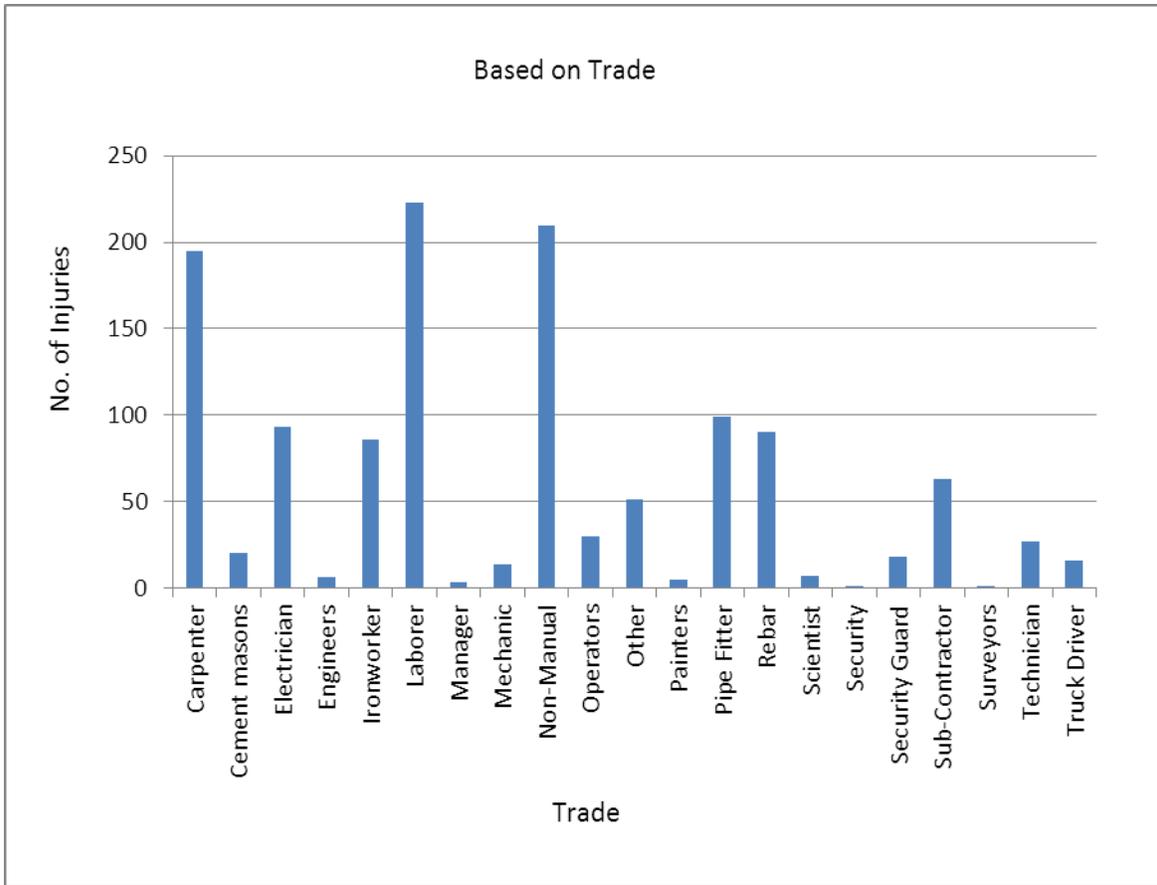


Figure 5-6. Number of injuries to workers performing different trades

Table 5-1. Number of injuries based on body parts and OSHA recordable criteria

Body_Part_Injured	Total	OSHA Recordable			
		No	%	Yes	%
Abdomen	4	2	50.00	2	50.00
Ankle	11	10	90.91	1	9.09
Arm	148	126	85.14	22	14.86
Back	162	117	72.22	45	27.78
Chest/Ribs	14	7	50.00	7	50.00
Ear	12	6	50.00	6	50.00
Elbow	74	62	83.78	12	16.22
Eye	68	57	83.82	11	16.18
Face	36	26	72.22	10	27.78
Groin	8	5	62.50	3	37.50
Hand	385	289	75.06	96	24.94
Head	27	25	92.59	2	7.41
Hip	12	10	83.33	2	16.67
Knee	36	33	91.67	3	8.33
Leg	160	100	62.50	60	37.50
Neck	63	30	47.62	33	52.38
Pelvic	3	1	33.33	2	66.67
Shoulder	35	30	85.71	5	14.29
TOTAL	1258	936	74.40	322	25.60

Table 5-2. Number of injuries based on days of week and time of day

Day	Total	Qtr 1	%	Qtr 2	%	Qtr 3	%	Qtr 4	%
Monday	296	55	4.37	34	2.70	24	1.91	183	14.55
Tuesday	289	74	5.88	37	2.94	42	3.34	136	10.81
Wednesday	281	69	5.48	31	2.46	41	3.26	140	11.13
Thursday	278	55	4.37	29	2.31	40	3.18	154	12.24
Friday	83	23	1.83	16	1.27	15	1.19	29	2.31
Saturday	24	7	0.56	3	0.24	3	0.24	11	0.87
Sunday	7	1	0.08		0.00	3	0.24	3	0.24
Total	1258	284	22.58	150	11.92	168	13.35	656	52.15

Table 5-3. Number of injuries for specific causes of injuries

Cause_of_Injury	Total Injuries	%
Body Mechanics	183	14.55
Caught in between	106	8.43
Chemical Reaction	22	1.75
Electrical Shock	1	0.08
Extreme Weather	17	1.35
Foreign Body	19	1.51
Insect Bite	67	5.33
Noise/Dust/Radiation	14	1.11
Not applicable	3	0.24
Other	26	2.07
Repetitive Motion	146	11.61
Slip, Trip, Fall	177	14.07
Struck by object	459	36.49
Tool	15	1.19
Vehicle/Equipment	3	0.24
Total	1258	100

Table 5-4. Number of total injuries for different natures of injuries

Nature of Injury	Total	%
Abrasion	160	12.72
Amputation	1	0.08
Burn	24	1.91
Chemical Reaction	5	0.40
Contusion	215	17.09
Dislocation	5	0.40
Electric Shock	2	0.16
Foreign Body	63	5.01
Fracture	25	1.99
Hernia	3	0.24
Insect Bite	67	5.33
Laceration	201	15.98
Physical		
Exhaustion	5	0.40
Puncture	75	5.96
Sprain/Strain	393	31.24
Stress/Fatigue	14	1.11
Total	1258	100

Table 5-5. Number of injuries to workers performing different trades

Trade	Total Injuries	%
Carpenter	195	15.50
Cement masons	20	1.59
Electrician	93	7.39
Engineers	6	0.48
Ironworker	86	6.84
Laborer	223	17.73
Manager	3	0.24
Mechanic	14	1.11
Non-Manual	210	16.69
Operators	30	2.38
Other	51	4.05
Painters	5	0.40
Pipe Fitter	99	7.87
Rebar	90	7.15
Scientist	7	0.56
Security	1	0.08
Security Guard	18	1.43
Sub-Contractor	63	5.01
Surveyors	1	0.08
Technician	27	2.15
Truck Driver	16	1.27
Total	1258	100

CHAPTER 6 ADVANTAGES AND LIMITATIONS

Microsoft Access 2010 is useful tool for database management. Though there are no specific disadvantages associated with the use of Access for managing the data, some limitations can be observed when using it for managing data with large numbers of subcategories. Following are the advantages and limitations of Microsoft Access 2010 for the specific application of documenting injury data and returning summary information.

Advantages

1. Access is easily available as a part of Microsoft Office package and does not require a separate purchase, which makes it economical to use.
2. Access can be used by any individual having average computer literacy and data can be entered even by a user who is not accustomed to using of computers.
3. New users can easily learn Access in significantly less amount of time using the online tutorials or the help functions. It is relatively easy since it does not require any major coding for general purpose use.
4. The Access interface is familiar to most users as its appearance is similar to Microsoft Excel. The data view and the design view make it easy to set up Access and start using it.
5. Desired formatting can be enforced easily when entering data through the data entry forms. Cell formatting rules to make sure that right kind of data is entered.
6. Access has become an industry standard in desktop use and the database engine is quite powerful.
7. There are a large number of templates, including the ones that can downloaded online, which makes creating new databases quite easy.
8. Inbuilt templates can be customized to make adjustments to fit specific needs of the user.
9. Connectivity options are a strong. Access databases can connect to Excel tables, Word documents, SQL Servers, and SharePoint Services sites for live data.
10. Tables created can be linked and used for generating reports. These reports give a better view/analysis of the data.

11. Multiple reports can be created from the same set of data. Grouping, sorting and filtering options can be used to get more perspectives on the same data. Real time previews allow different versions of the report to be created for various audiences.

Limitations

1. Access requires some background work before getting used to it.
2. The forms and queries designed for entering and extracting data are simple to use, but modifying those forms and queries requires an average knowledge of Access.
3. It is easy to accidentally mess up the layout and the form or query design if the database is not restricted to a specific user who only enters or extracts the data.
4. The form and query design becomes increasingly tedious with more and more fields added to the database.
5. Modifying and customizing the reports based on requirements which vary from one construction site to another require small amounts of coding which can be done only by an individual familiar with Access.
6. Reports if not generated properly can give the information not required and can run into pages.

CHAPTER 7 CONCLUSIONS AND RECOMMENDATIONS

Microsoft Access 2010 is useful for managing data and providing a construction site with a readily available data recording and extracting tool. The database, if required, can be generated within a matter of hours and made available for use. The data can be entered and extracted easily by a user having no prior knowledge of Access. Reports can be generated as required to get an overview of the injury records and the factors associated with it and come up with measures for preventing future injuries.

The analysis of the injury data proves that Access can be used to analyze a set of given data and the database can be modified to suit the need of a particular construction site.

It is recommended that the Access database be maintained by a person familiar with Access functions. An individual well versed with Access can get the database ready to use in a matter of hours. Access is easy to use by users not familiar with it, but the designing of the database should be preferably done by an experienced user. The database design should be inaccessible to the users. The only function that the users should be allowed to use should be data entry, data extraction and report generation. This will prevent any changes in the code or the design of the database. Thus, Access is a useful tool for recording and analyzing First Aid construction worker injury data.

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BIOGRAPHICAL SKETCH

Milind Ramakant Gholap achieved his Bachelors in civil engineering from Mumbai University in the year 2007. He worked for a major construction firm in Mumbai and served as an engineer on residential and commercial building projects. After a year of experience in the construction industry he decided to further pursue his interest in the field of construction project management by going for his Masters degree. He graduated with a Masters in building construction from the University of Florida in 2010. He aims to start a building construction firm after few years of experience in the United States and is currently working to get a firm foothold on the knowledge in the field of construction project management.