Roof Management Database: A Web Enabled Database for Facilities Management at the University of Cincinnati

By

Kevin S. Bivens

Submitted to
the Faculty of the Information Engineering Technology Program
in Partial Fulfillment of the Requirements for
the Degree of Bachelor of Science
in Information Engineering Technology

University of Cincinnati
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Kevin S. Bivens, Student — Date

Robert Schlemmer, Faculty Advisor — Date

John Sullivan, Department Head — Date

Acknowledgements

I would like to first thank my parents Edward Patton and Connie Bivens for believing in me when I did not believe in myself. Thanks to the rest of my family for your encouragement and faith that I could do it. Thanks to my girlfriend who has been ignored for the last two years, thank you for your support and most of all your understanding. Special thanks to Dominic Ferreri, Timothy Mcdade, and George Russell from Computer and Network Support for Facilities Management for your patience through my many mistakes and the opportunity to work with you all. Last but not least, Professors McMahon and Schlemmer for having confidence in my work.

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Abstract

Roof Management Database is a website designed to provide Facilities Management a central repository of information concerning roofs. The previous system was an excel spreadsheet located on a shared network drive that only one department had access to. RMD was conceived due to the widespread development and continued growth of the University. There is a need for a more robust system that can track historical data as well as report important information. The decision to make RMD a Web enabled tool stemmed from the apparent distribution issue, since the University maintains more than 75 buildings spread throughout Cincinnati.

The site is being developed on a Windows server 2003 Web server with a MS SQL 2000 database. The site is programmed using Visual Studio .NET C# using ASP.NET. With the potential for novice users interfacing with the site, I have made a conscious effort develop a user friendly environment that is intuitive and simple to use. When initially proposing this project I inquired on the security necessary to secure this information. Security of the site is handled by the Web server which will require domain level authentication before granting access. Once signed on to the site the administration page is secured by a database username and password as well. Creating RMD will enable more users throughout Facilities Management the ability to view and change data without making a phone call. For many users this will save time and provide more accurate and on time data collection.

1. Statement of Problem

Computer and Network Support have given me the task of creating a database which will track and modify information about the roofs at the University. It is important for Facilities Management to track warranty and repair information to maintain the strength and stability of these roofs. Currently, all information concerning the maintenance of the roofs is stored in SQL tables that are difficult to navigate and update. The current procedure requires the user to sort the data to an intelligible format, and then find the specific record. RMD (Roof Management Database) will have the ability to navigate to a specific building and then select the building or area you wish to find. Completing this project will target database, and web design and programming.

The site will also be able to generate reports that will tell the user what maintenance is up and coming, and what warranties are up for renewal. This information will be used by manages, Associate Directors, Directors and possibly VP of Business and Administrative Services, James Tucker. These individuals will use this information to request services that these roofs will need. The database will assist these professionals in contacting vendors for warranty purposes, will justify maintenance or replacement of roofs or their parts, and help streamline the current process.

In speaking with Dominic Ferreri (1), Manager of Computer and Network Support, I was lead to the conclusion that creating this site will assist project managers and quality assurance staff to better gauge cost and maintenance requirements. John Good (2) has been employed at the University as an Information Analyst for six years. He is well versed in the entire Visual Studio suite and is more than capable of supporting this software for future development. John (2) would like the code for the project to be

well documented in the event he must maintain the program. In a meeting with John Good, Dominic Ferreri, and myself, I was given several requirements the product should meet:

RMD should provide users with the ability to:

- Generate and review reports on warranty, maintenance history, and cost.
- Update existing maintenance and warranty information.
- Allow users to sort through data and easily access each building.
- Provide concurrent access to data but allowing only one user to update at a time.
- The end product should be user friendly and allow a novice computer user to understand the program.
- Provide security for all data held within SQL Server.
- Documented for readability with HTML comments.

2. Description of Solution

Roof Management Database (RMD) is a web-based application designed for use by managers, associate directors, and directors within Facilities Management at the University of Cincinnati. These users will use this tool to track and monitor vital information and conditions for all the roofs at the University. The current system uses an excel spreadsheet that is difficult to read and provides users little useful information. RMD will also provide information in reports that will assist upper management in making business decisions based on specific criteria. The database will store the last known condition of the roofs as well as warranty and vendor information. The goal of

RMD is to provide an easy to use repository that is web-based and accessible throughout the department.

2.1 User Profile

There are three major groups who will use RMD: managers, associate directors, and directors. These levels are distinct from each other not only by duties and responsibilities but also skills. They provide a diverse mixture within Facilities Management that must be accounted for.

The first group consists of building managers. These users are typically not highly skilled with computers. Most of those women and men are skilled at a trade such as carpentry, electrical, HVAC and other skills. Managers are responsible for keeping up-to-date information in the database and are the primary users of the interface. These individuals understand basic input and output uses of computers. They rely heavily on an in-house application, work control, to delegate tasks and monitor work requests. Their duty is to ensure work orders are handled efficiently and properly documented.

The second group includes associate directors. There are currently three associate directors within Facilities Management. The primary use of RMD for these users will include making proposals for work to be completed and budgeting. Associate directors report to upper management concerning all works and the overall performance within their respective areas. Organizational performance has a stake in this area. This group works within the University to ensure the quality and accuracy of work within the division. By using RMD these individuals are able to report up-to-date and accurate statistics on building as a whole.

The final group of users will have limited interaction with the software as a whole. These users will merely use the web site for occasional research and specific reports. Directors will use the site to verify information reported by managers and associate directors. Due to the wide range of responsibility they have directors will rarely use the interface so it must be fast and easy to use. Typically these users are more experienced in using the reporting functions of a computer. Directors are constantly reading budget reports and proposals which will enable them to quickly search for the information they require with minimal technical support.

2.2 Design Protocols

Roof Management Database (RMD) pulls the resources from several aspects of information technology. With a wide variety of options to choose from the decision was made to program RMD in Visual C# using ASP.NET, and XHTML with a SQL server 2000 back end. In choosing these technologies the management of Computer and Network Support of Facilities Management considered the useful life of the application, maintenance, and extensibility. Below I have detailed some of the benefits discussed that enabled the final decision

C# was selected for its extensibility and robust nature that gives RMD to have an extended life by using some of the latest technology available. ASP.NET is a tool that connects the facets of the project (Database and, Programming) to the distribution medium via the Intranet. The site resides on a department (Facilities Management, University of Cincinnati) owned and managed IIS web-server running Windows Server 2003. Data is stored on another department server running Microsoft SQL 2000 server.

SQL 2000 was selected for its extensibility and strong track record for constant data storage and reliability. Below is a detailed account of the user interface, database relations, and data tables within the project. Developing RMD with this utility also provides the ability for future growth and tracking capabilities. At some point it may become necessary to integrate RMD with other building maintenance information to create a data warehouse.

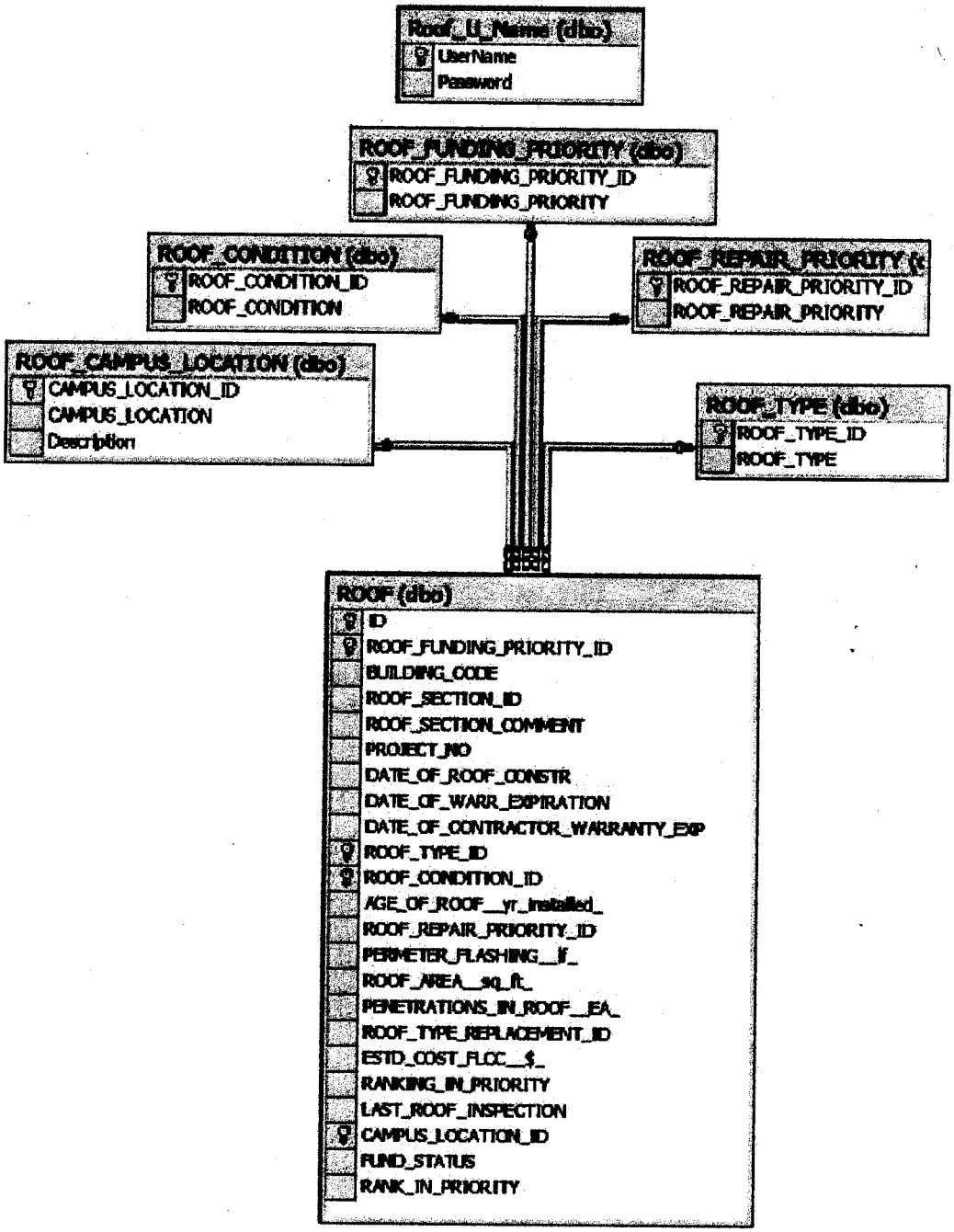

Figure 1. Depicts the relations held between the data tables and how they will interact through primary keys.

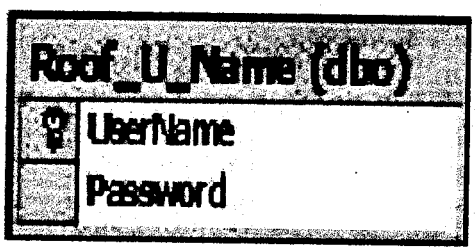

Figure 2. Roof_U_Name houses user information for the administration web page

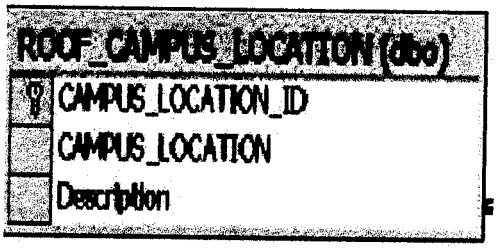

Figure 3. Campus location describes the physical location of the buildings

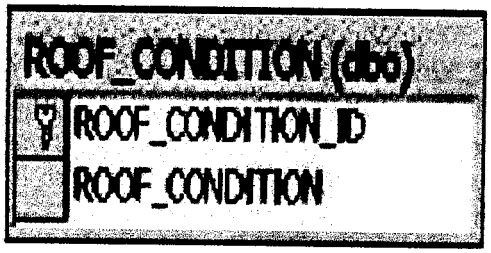

Figure 4. Stored in roof condition is a measure of the physical state of the structure.

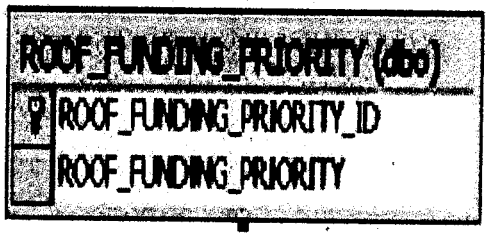

Figure 5. Funding Priority details the order in which money should be spent based on repair priority. This may be changed depending on the roofs condition

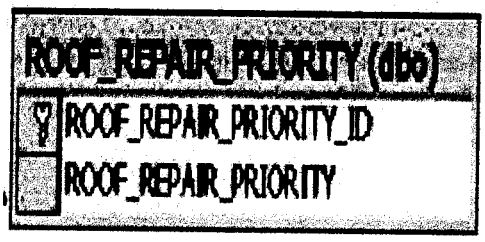

Figure 6. Repairs will be made to each roof depending on the condition of the roof and funding priority

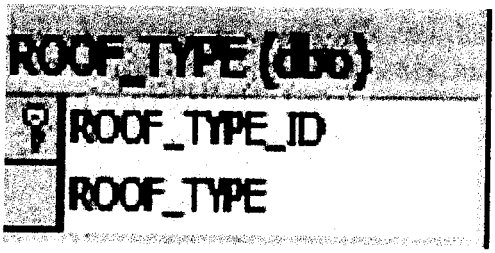

Figure 7. Roof type defines the building materials used to construct the roof. This may very depending on builder and the purpose of the structure.

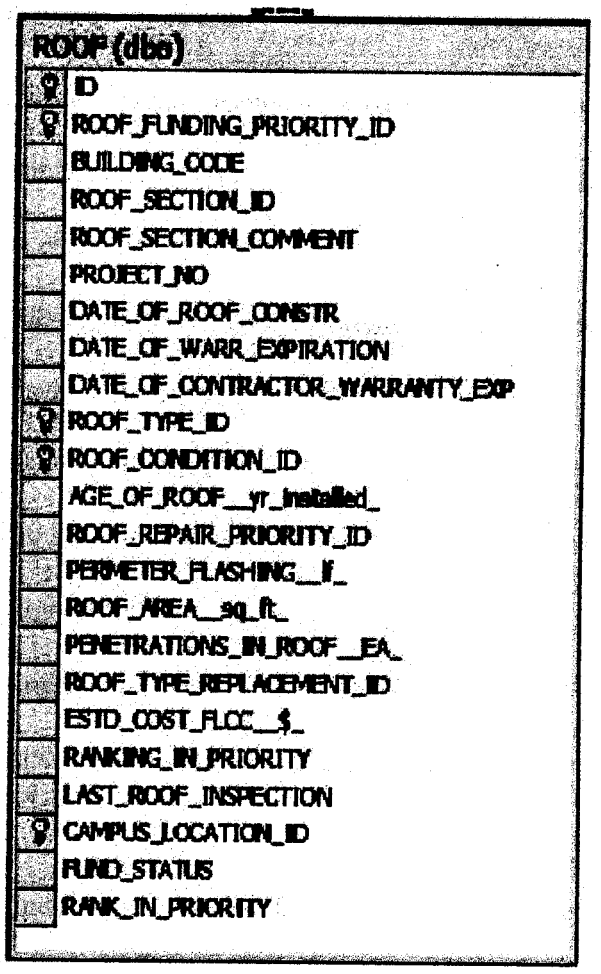

Figure 8. Above is the heart of the database which stores pertinent information regarding each roof and describes in detail the construction, cost, warranty, and repair information for the structures.

3. Deliverables

1. Provide a web interface that is easy to use and navigate to track warranty, repair, and vendor information using ASP.NET, XHTML, and SQL.
2. Prepare a central resource with multiple users in mind.
3. Include security through windows authentication and administration that is password protected. These users are able to add or delete building. Create new users with administrative functions.
4. Develop an easily maintainable and sustainable solution that is extensible.
5. Connect to the SQL 2000 database to store normalized information.
6. Allow users to find and update information that can be used by upper management to generate intelligible reports to make appropriate business decisions.
7. Reports will include up and coming scheduled maintenance, warranty expiration, Building priorities both replacement and repair, Roof condition reports showing how many buildings are in need of service.

4. Design and Development

Developing Roof Management Database was developed over the course of three quarters. Below I have listed my timeline, budget, and resources used throughout development.

4.1 Timeline

The timeline presented shows the completion of all aspects beginning in September 2003 and finishing with my presentation March 2005.

Resources and Assignments	Start	Finish	Complete
Research Project	09/24/03	11/06/03	X
Write Draft Proposal	10/30/03	11/06/03	X
Write Final Proposal	11/04/03	12/01/03	X
Present Proposal	12/04/03	12/04/03	X
Install & Configure Computer	12/29/03	12/29/03	X
Design Database	01/12/04	03/19/04	X
Normalize Database	02/09/04	03/05/04	X
Design Application	02/16/04	04/09/04	X
Develop Application & Database	08/30/04	11/15/04	X
Test Application and Database	11/05/04	11/18/04	X
Write Senior Design II Design Freeze	09/01/04	11/30/04	X
Senior Design II Presentation	12/03/04	12/03/04	X
Complete Design & Testing	12/20/04	03/12/05	X
Prepare All Final Documents	01/14/05	03/12/05	X
Present Final Product & Documents	03/12/05	03/12/05	X

Figure 9. Timeline

4.2 Budget

The budget below uses information gather at retail prices of all hardware and software used. The project presented no out of pocket cost to me as Facilities Management supplied all resources.

1	Dell Optiplex GX2800	Dell	928.00 [1]
1	PowerEdge 6650- SQL 2000 Server	Dell	11,072.64 [1]
1	PowerEdge 2850 – Web Server	Dell	3,608.32 [1]

1	Windows XP Professional	Microsoft	279.99 [2]
1	Windows 2000 Server	Microsoft	869.99 [2]
1	Windows Office 2003 Professional	Microsoft	409.99 [2]
1	Visual Studio .Net Professional Version 2003	Microsoft	170.00 [2]
1	SQL Server 2000 Standard	Microsoft	2474.99 [2]
1	Adobe PhotoShop 6.0	Adobe Systems Incorporated	649.00 [3]
Current Total			**$ 20462.92**

Figure 10. Budget (Prices may vary depending on government contracts)

4.3 Resources

For this project to be a successful there are several hardware and software products that were required throughout development.

- Web Server
- Desktop computer for development
- Visual Studio 2003
- Report Services for SQL Server 2000
- SQL Server 2000
- Adobe Photoshop
- Microsoft Project for scheduling purposes

Since RMD is a website, the Web Server will host the application. Visual Studio 2003 was selected for its great ability to create .NET applications. SQL Server is the database of choice for Facilities Management as it has become a standard for all new applications, big or small, to be developed with SQL Server. Adobe Photoshop was used

to create and modify images that were included in the website. The specifications for the computer I will use are listed below:

- 2.20 GHz Pentium 4 processor with 400 front side bus
- 512 DDR SDRAM at 333 MHz
- 40 GB Ultra ATA / 100 7200 RPM hard drive
- 17 inch monitor

5. Proof of Design

Below is a detailed account of how my deliverables have been satisfied with brief descriptions of the content and ideas that aided in development.

5.1 Logon Prompt

Only authenticated users with a Facilities Management domain account can access the web site. Also the site is only available to users within the Universities network. Users can gain access using either the University provided dialup service or VPN connection when off campus.

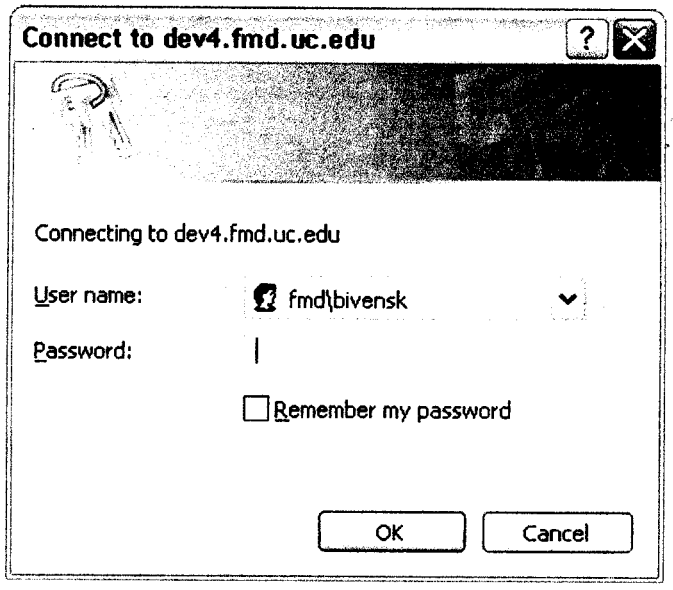

Figure 11. Authentication Prompt

5.2 Splash Screen

The splash screen clearly identifies what site the user has accessed as well as provides a brief description of Facilities Management, their core values, mission and vision. Users are presented with navigation on the left hand side, which will guide them to the appropriate page to complete their task. Users are given the option of entering a given campus to that will direct them to select the building of choice. Permitted users are

able to administer the buildings or add users. I have also included links that allow the user to navigate to the Universities home page, access reports, or visit a help function that explains navigation and intended use.

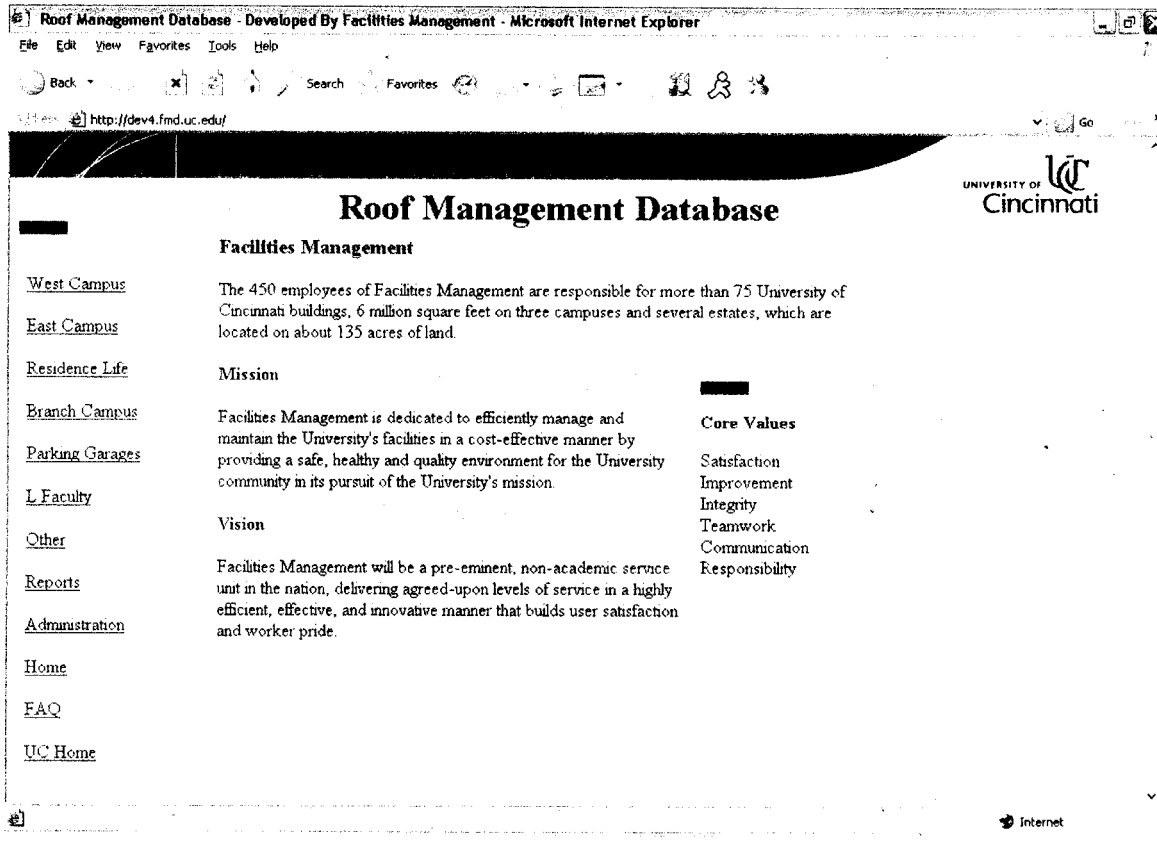

Figure 12. Splash Screen

5.3 Data Page Example

As seen below users can review, edit, submit, or reset the content of the page. The layout was selected to allow easy use and visibility of any portion of the page. The other location links are identical to the example below to provide consistency. Each page clearly identifies which campus the user is referencing. When selecting a building the data base is queried to only pull the buildings for that campus. Once the user selects the appropriate building the data is populated. The submit button has been disabled until the user takes the appropriate action to edit the data. Once the user has entered edit mode

they have the options to either return to view mode, reset or submit any edited content. Users may select from any predetermined filed, added or edit specific data, add or remove comments.

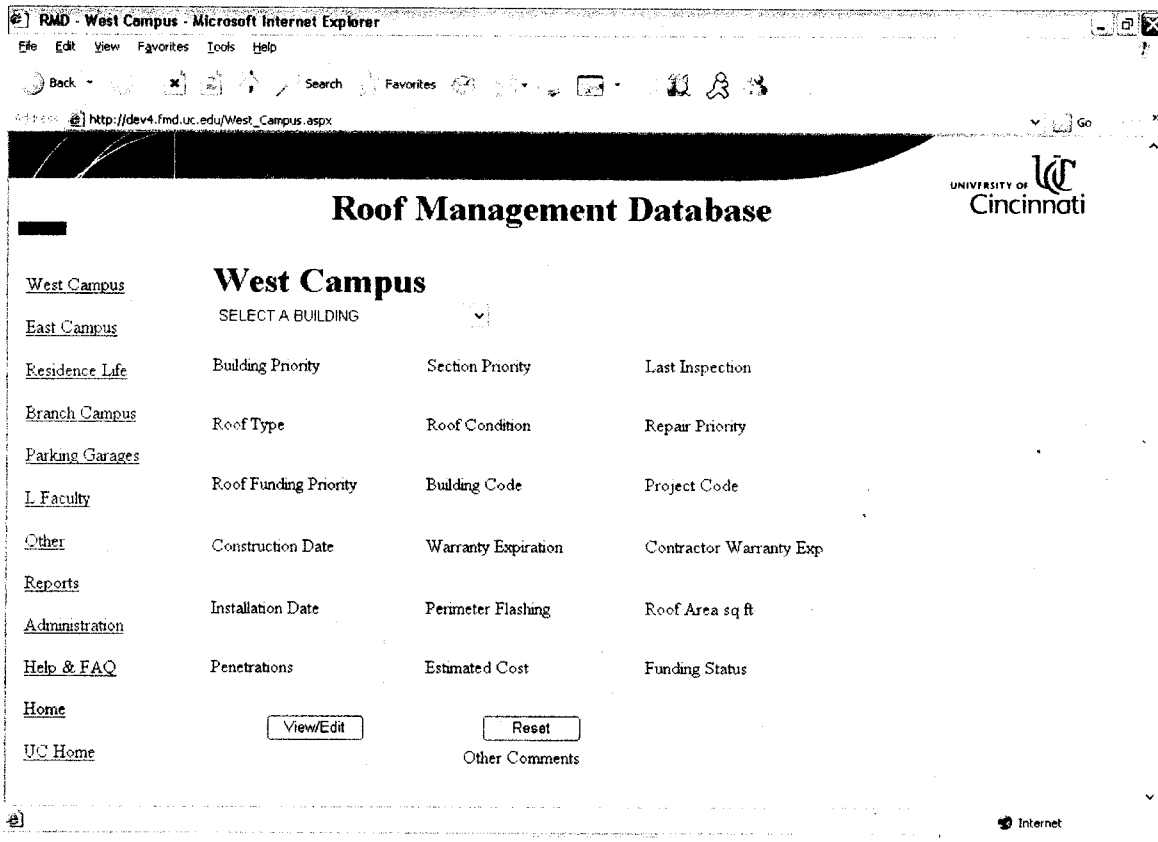

Figure 13. Data Page Example

5.4 Frequently Asked Questions

Users have the opportunity to find help on the FAQ & Help page. Here users can find a project description, and answers to questions raised during testing phase of development. Users must click the centrally located links to which will move the web page to the appropriate FAQ. Users then have the option to scroll through the page or click the Top link to return to the beginning of the page. Below I have included two screen shots that depict the layout and functionality of the Webpage.

5.4.1 Frequently Asked Question – Navigation

Users are able to select the appropriate question to navigate to the answers listed below. User can continue to use the navigation in various locations on the page.

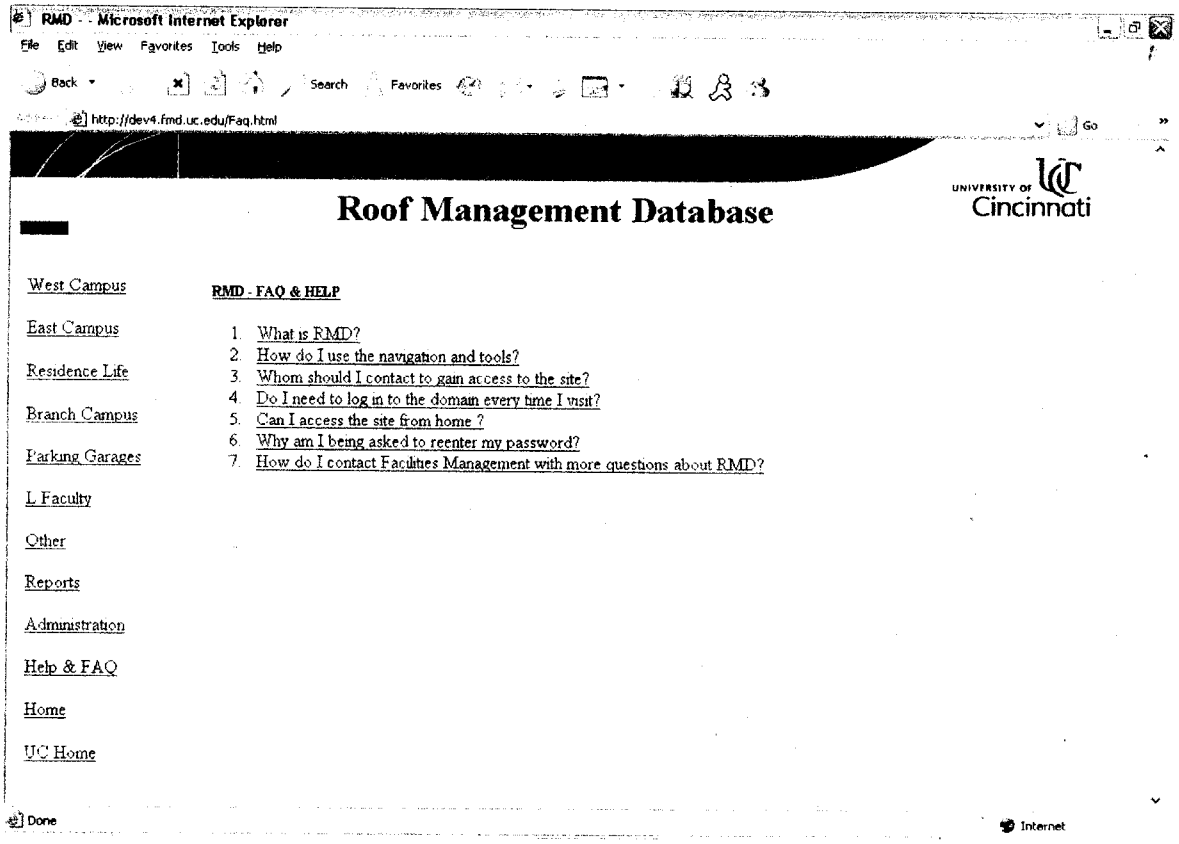

Figure 14. Frequently Asked Questions - Navigation

5.4.2 Frequently Asked Questions – Data

Once users have selected the appropriate question they are directed to the answers in example below. From here user can review the information and when finished click top to return to the beginning of the page. Now the user has the option of choosing another FAQ or using the navigation provided throughout the site.

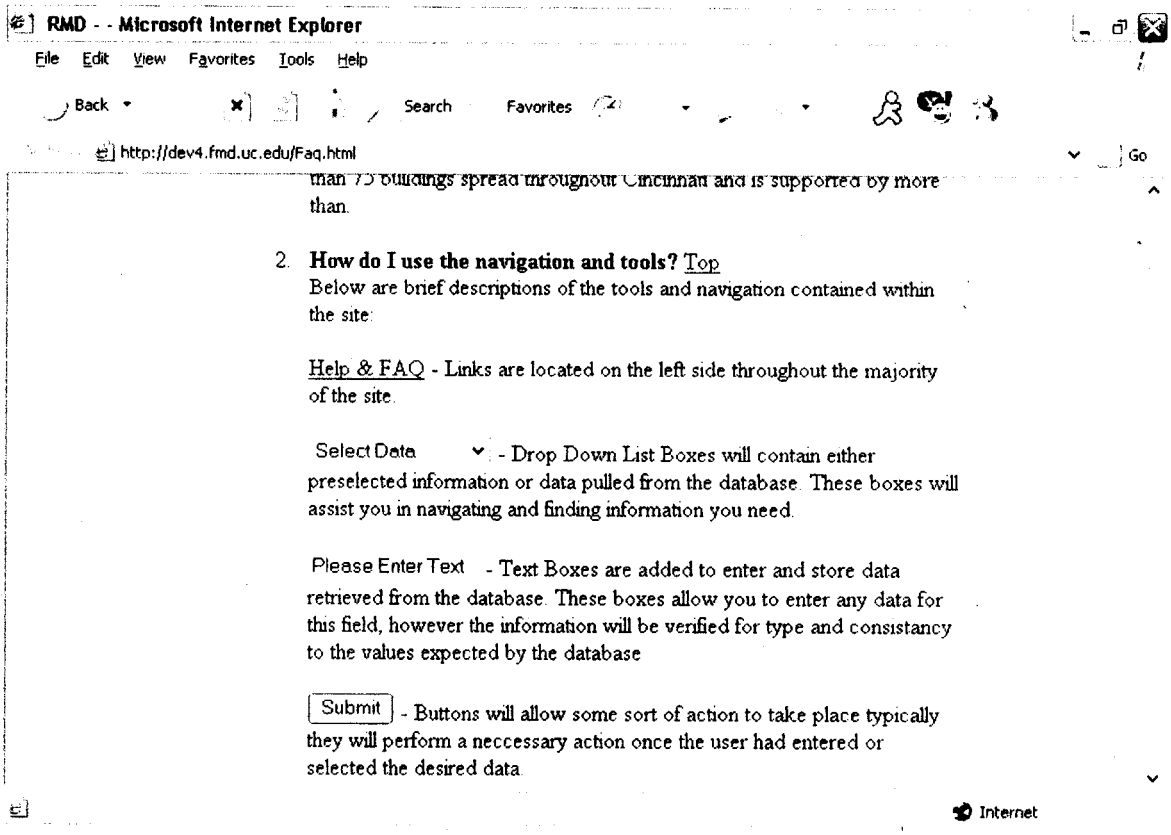

Figure 15. Frequently Asked Questions

5.5 Reports

The reports section includes a rotation of pictures driven by JavaScript. The pictures include depictions of the University of Cincinnati sign located at the corner of Clifton Avenue and Martin Luther King Drive. There is a drop down list that includes three reports roof condition, warranty expiration, and repair priority. The reports are generated in HTML by report services which is a product developed by Microsoft to integrate with SQL 2000 Services.

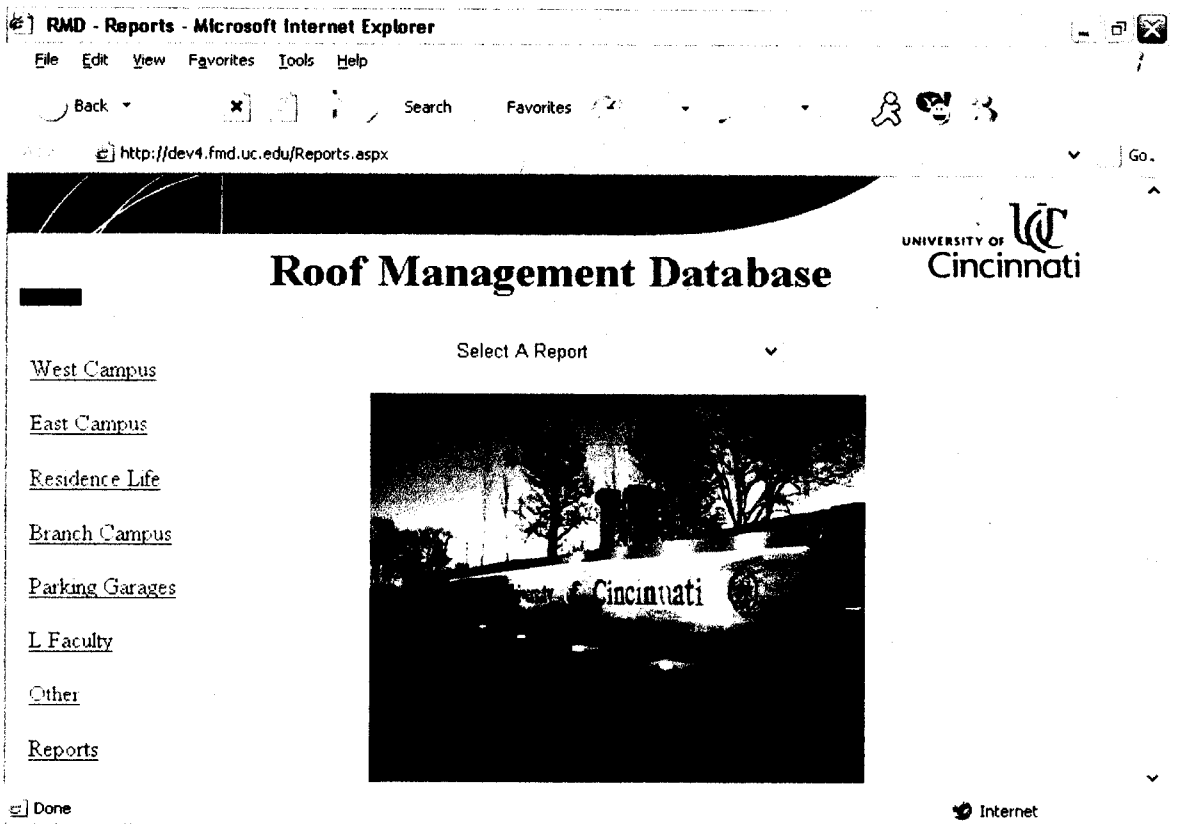

Figure 16. Reports Splash Page

5.5.1 Condition Report

The first report is gives a detailed report of the most current roof conditions. This data is pulled directly from the database and compiled into a logical format that list section comment, repair priority, type, and the year of installation grouped by the roofs conditions. The condition will allow users to easily decide which roofs deserve immediate attention compared to others.

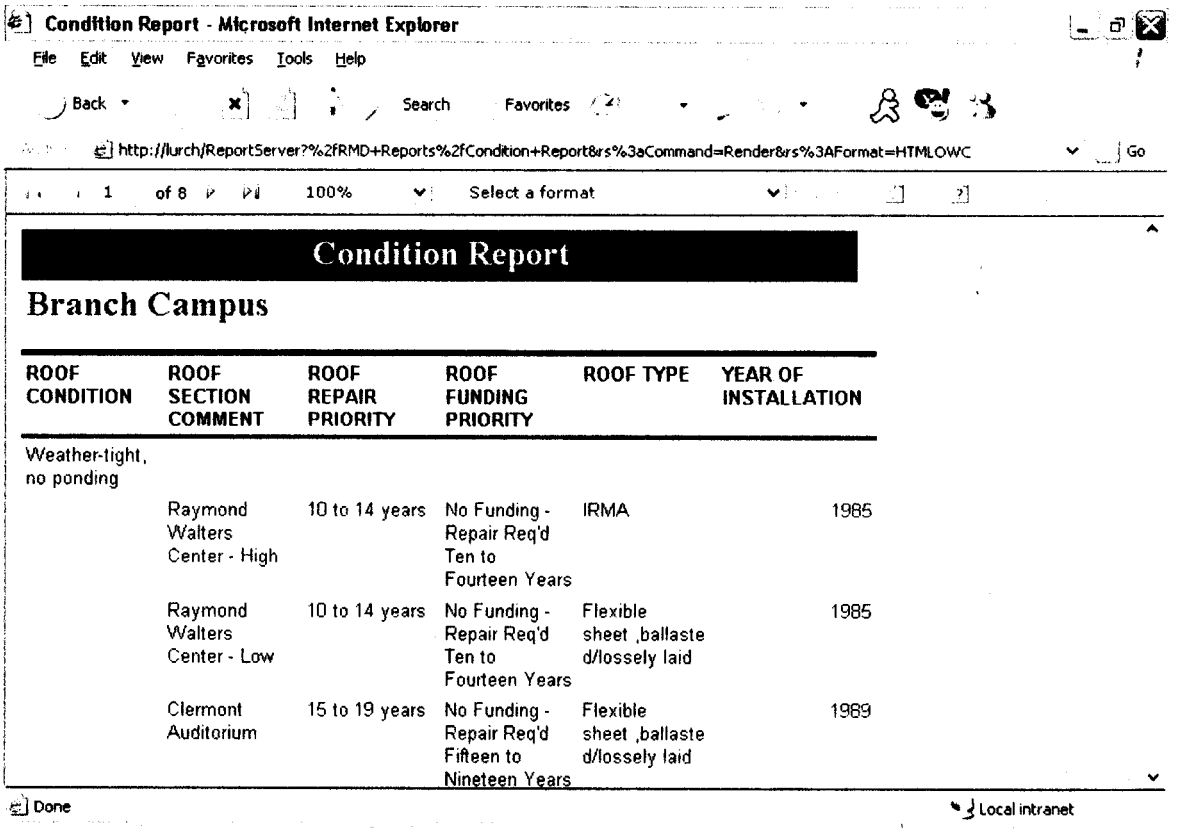

Figure 17. Condition Report

5.5.2 Warranty Expiration

Warranty expiration gives an account of what roof warranties are currently expired and which roofs will be expiring in the near future. Users will easily be able to contact vendors for extended warranties where deemed necessary. This data is grouped by year and details the section comment, building code, campus location, and repair priority amongst other details.

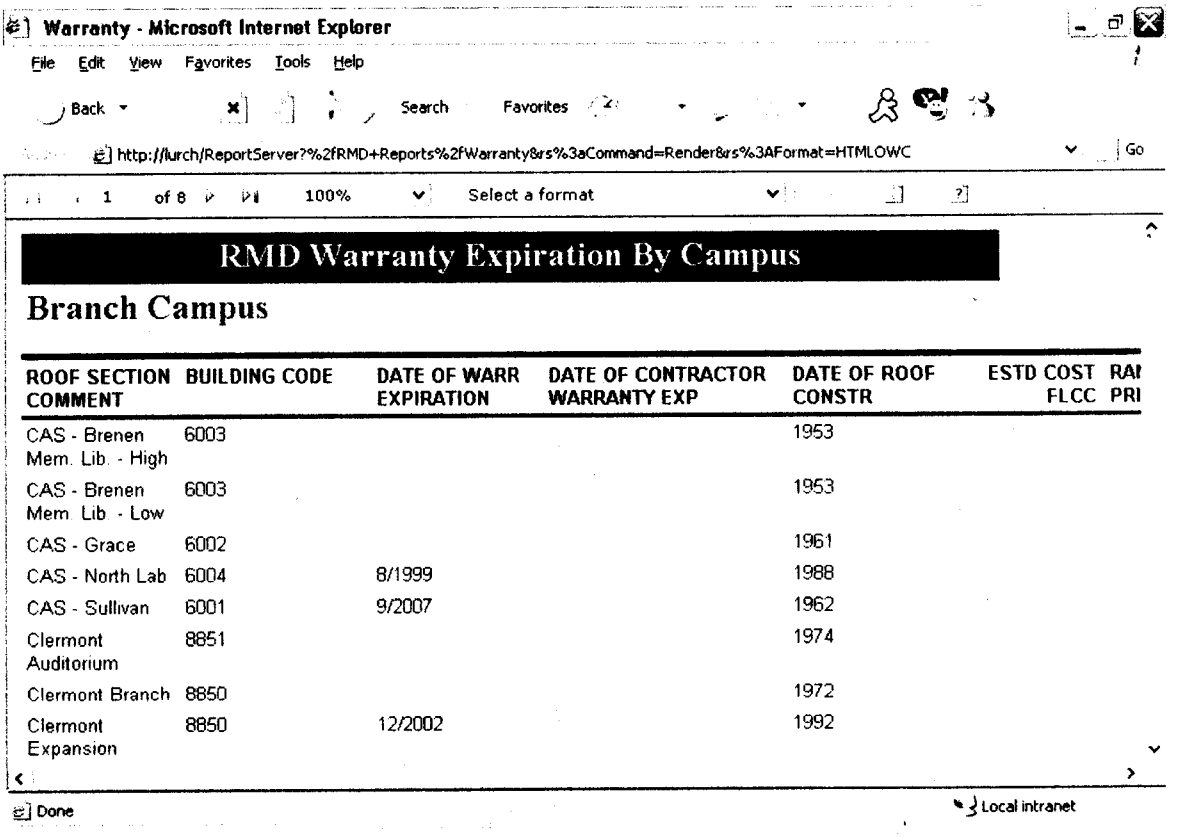

Figure 18. Warranty Expiration

5.5.3 Repair Priority

Repair priority allows the department to verify which roofs are the most mission critical in the case of regular or emergency repair. This report will allow managers to schedule maintenance and inspections of the roofs based on their priority level. The list is grouped by year and campus location. The report also details the section, condition, last inspection, and funding priority.

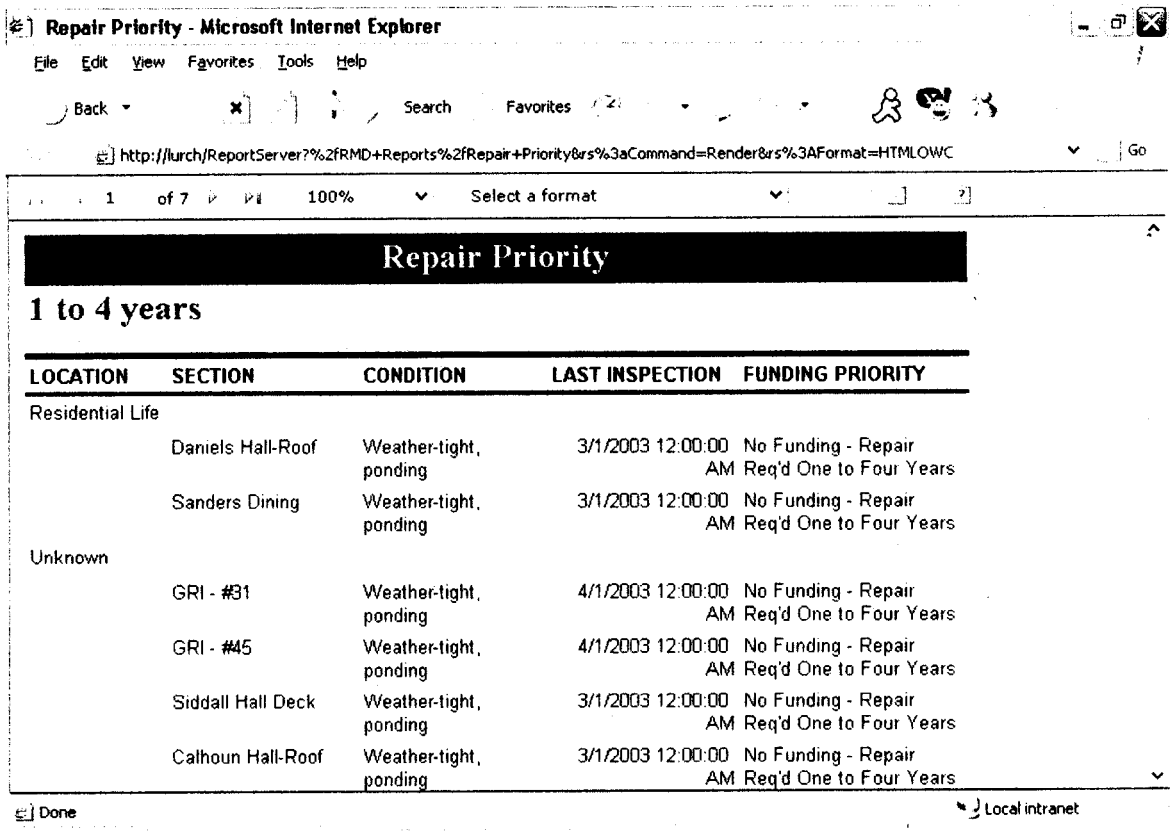

Figure 19. Repair Priority

5.6 Administration Splash Page

When accessing the administration page users are prompted for a username and password which is housed within the users table in the database. This allows added security as only authenticated users have access to the page.

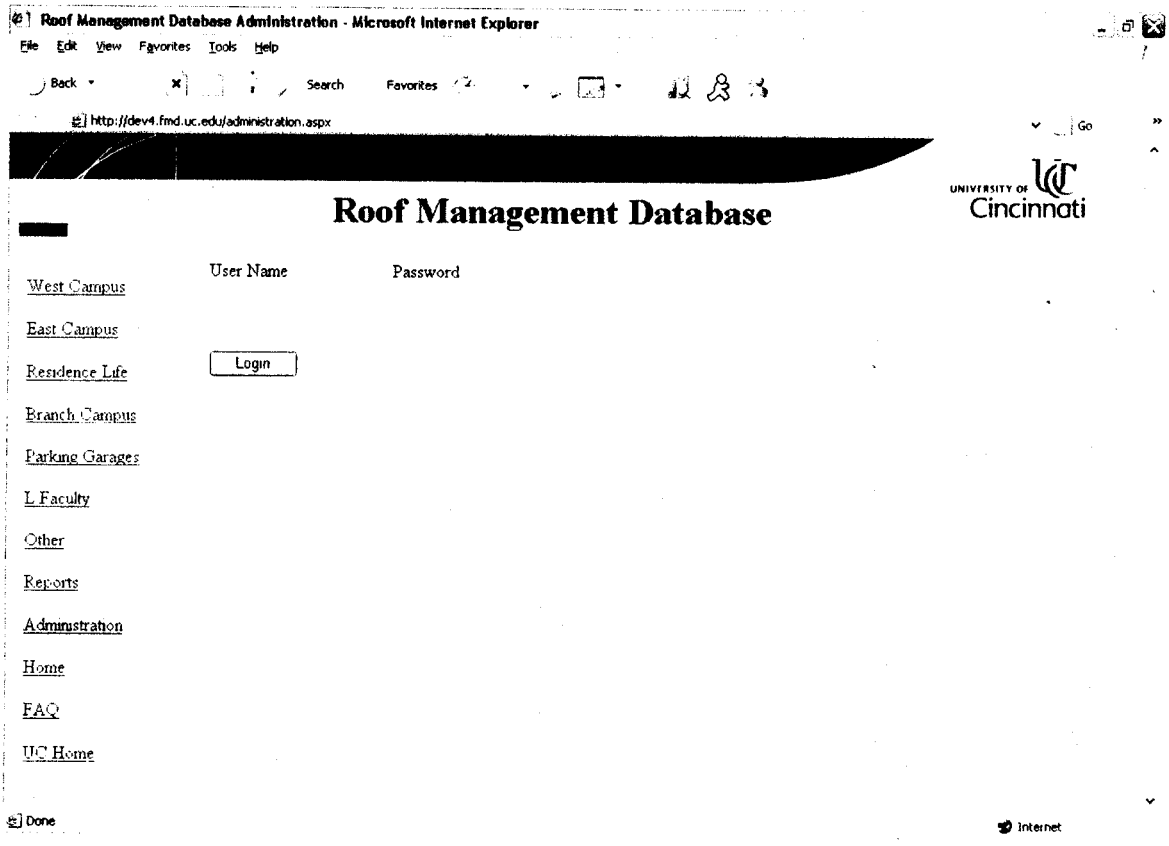

Figure 20. Administration Splash Page

5.6.1 Administration Selection Page

Once an authenticated user has successfully entered a username and password they are prompted to enter the appropriate portion of the administration site. Either the user can access user or building administration.

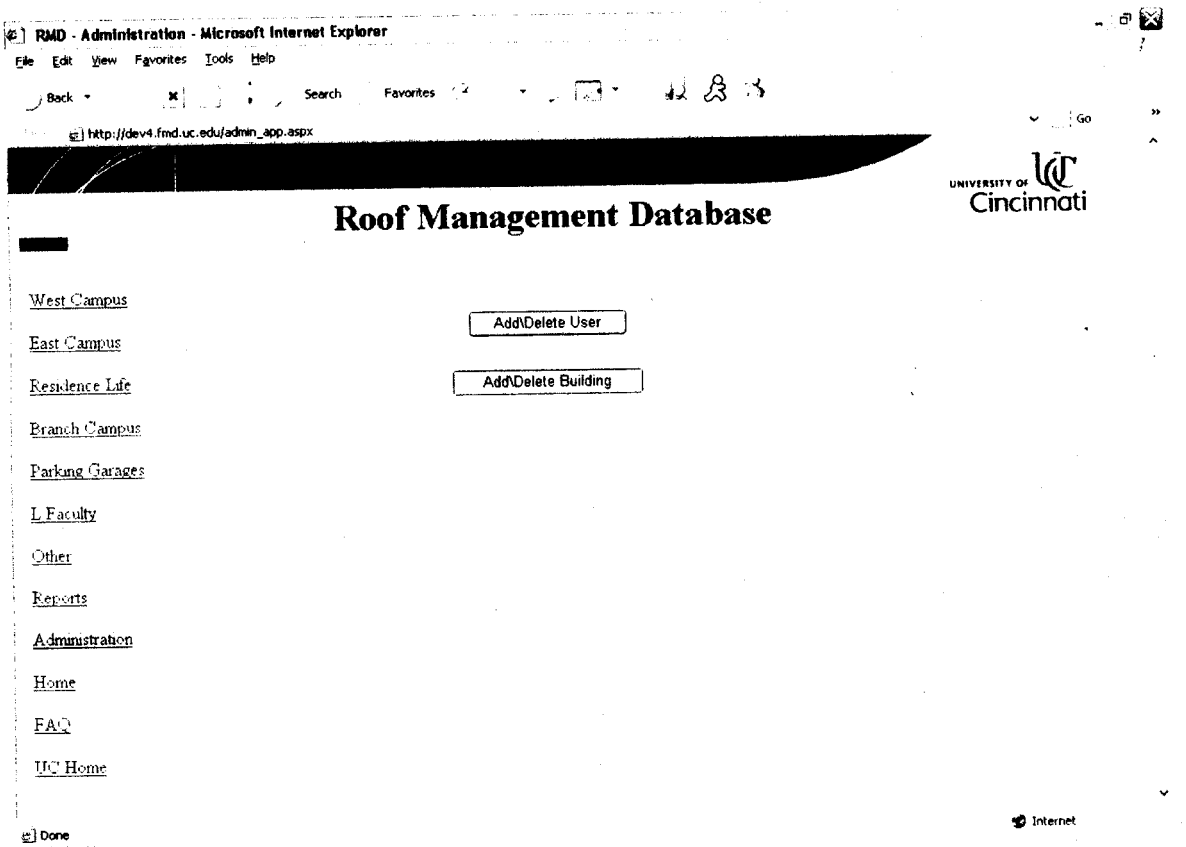

Figure 21. Administration Selection Page

5.6.1.1 User Administration

Once the user has selected the add/delete user button they can either added, edit, or delete a user from the system. In order to edit a user account the account must be selected in the provided pull down menu. In order for an account a user must click edit user, enter the information then select submit. This will grant the user the ability to add, or edit an entire building, create or edit other users on the system.

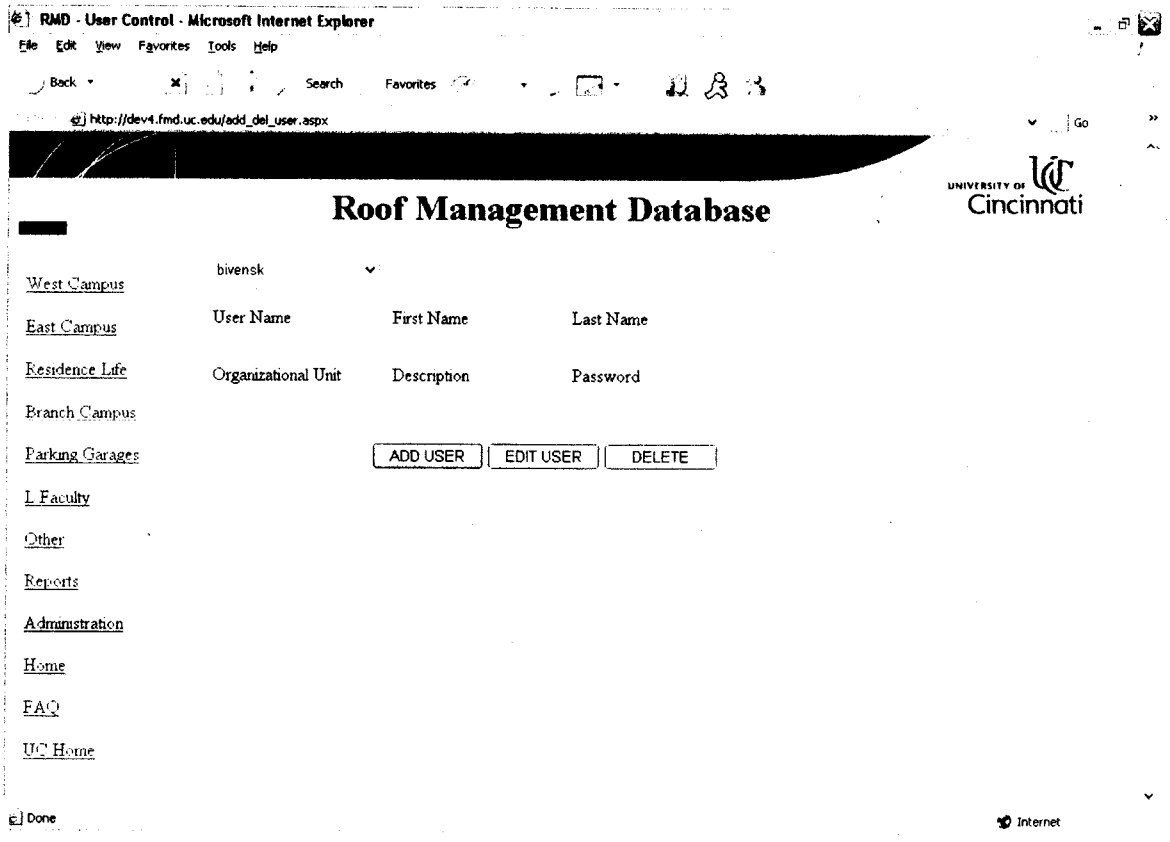

Figure 22. User Administration

5.6.1.2 Building Administration

From building administration users can add or delete new building. This will be prompted per management request only. It is vital that information be exact in this process as normal users do not have the ability to change campus location information. Users are prompted to either select a building to delete or enter information into the specified fields to add the building.

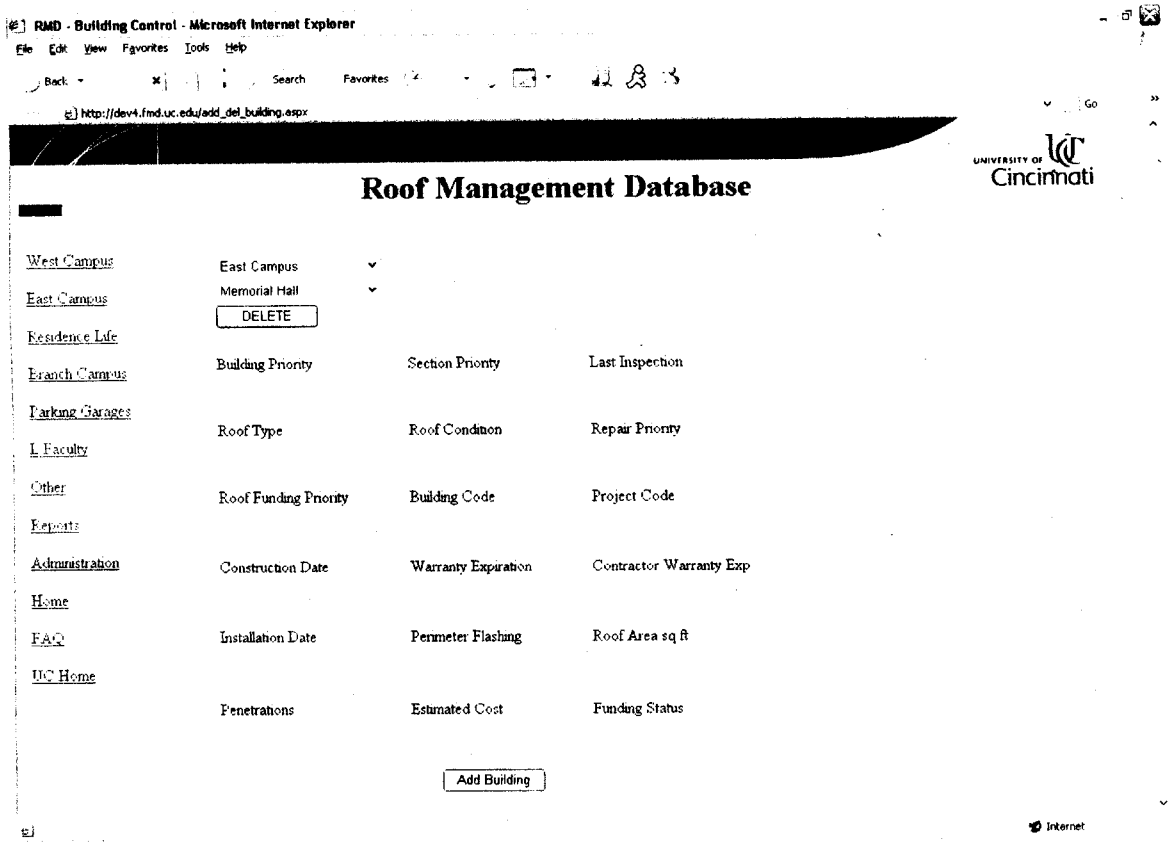

Figure 22. Building Administration

6. Testing Plan

In order to ensure the quality of the product RMD has been tested in three phases, by several focus groups including six members of work control, three department heads or managers, and three directors throughout the department. The first test was conducted after the creation of the design freeze. In this phase recommendations were taken to change several fields in to drop down menu's to retain consistency for preconfigured data. This included roof condition, repair and funding priority, and roof type. Management did not want to rely on users typing correct information for these fields. During this phase management also specified the types of reports they would like generated. They have specified warranty expiration by year, roof conditions, and estimated cost among other dynamically generated report.

During these test we specified that we would like the users to pay attention to the flow throughout the site. We did not want a user to ever feel that he or she did not know what action was expected. Users were pleased with the easy to use interface and consistent navigation throughout the site.

Overall the testing proved to be very informative and the level of acceptance was very good. With the modifications that have been proposed the final product has been successful.

7. Conclusions and Recommendations

7.1 Conclusions

Roof Management Database was designed to provide a central repository for the roofs of Facilities Management at the University of Cincinnati. I have provided the department with a useful tool that is concise, easy to use, and maintainable by the IT staff. The site was developed using C# with ASP.net with a SQL Server 2000 database. The site resides on a windows 2003 web server owned and operated by the University. Usability and consistent navigation were two of the main theme throughout the site. Users are now able to add, edit, delete data as well as view reports and manage data on hand. Through conversations and the focus group analysis the overwhelming majority of users are satisfied with the final project.

7.2 Recommendations

Throughout development of this project I have learned much about the politics and requirements of developing any application for the university which can be applied to any commercial or internal company project. Concentrating on coding the project will not gain acceptance nor will the end product be tailored toward your customer. It is imperative that the entire project is planned as much as possible. Reporting the status of each module will reduce the number of questions or concerns held by users and management. Communication between staff and departments must be maintained to improve quality and gain acceptance of any project. Without the support from several sources this project would have never been launched.

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