ABSTRACT

The frequency and variation of disasters occurring across the globe, have brought into focus the need for a comprehensive study of the disasters that have left in their wake a trail of raw data and experiential material which the engineer cannot afford to miss. Codes and practices are being reviewed to incorporate the changing face of disasters. With the availability of high end hardware and software, it is now possible to study each disaster for its complex demands that are dynamic in nature, and automate it into software. Thus the need to idealize and simplify these forces is obliterated so that the demand placed on structures in the form of extreme loads can be translated in its original complex form.

Literature review has shown that each disaster is being studied in the light of finite element analysis and non-linear static and dynamic response. There is also an emerging need for software that can handle parametric studies to understand the complex nature of the phenomenon and its effects. The software would also serve the dual purpose of examining various alternatives for retrofitting solutions as per current practices. Thus present work is focused on studying each disaster in a holistic manner and then to incorporate into a software the structural engineering aspects of each. Moreover the potential aspect of structural visualization has been built into the present work on a **Virtual Reality** platform by scripting 3 dimensional **GUI**. Thus the nature of the loads and the complex response of the building have been encased into software modules which enable the engineer to view them in a virtual world.

Structural aspects of the most devastating disasters namely earthquake, cyclone, fire and flood have been examined in current work along with those of blasts and tsunami. Software implementation of analysis, design and retrofit for each disaster, has been accomplished through separate modules. Combination of various software has been used to accomplish the end results. **VC++** has primarily been used to develop the main program in each module for evaluating loads arising in a building, owing to each disaster. Static and dynamic analysis for forces due to various disasters, have been programmed as per the **IS code**

requirements. Wherever there is a proposed draft code, options for both current and proposed codes are given to the user. Various **international codes** have also been examined vis-à-vis the IS codes and wherever found missing, important parameters have been adapted from its international counterpart .

Preliminary results of demand and capacity of the building for each disaster are obtained through software to check the adequacy of design with respect to local or global failures. Retrofit is done through stiffening by addition of new members or strengthening the damaged member. The analysis results and retrofit options are further used for implementing on the virtual reality platform interfaced into the software through **3DS Max** and **VRML** to study various parameters of damage.

Thus, even though major aspects of disasters have already been put under the scanner in separate research studies, the introduction of a VR platform and the software implementation by stretching the boundaries of existing codes imparts a new facet to the structural analysis and design of a problem that has traditionally been dealt with by either over-simplifying it for want of sophisticated analysis tools or interpreting in a simplistic manner for want of sufficient visualization.

An overview of the problem definition and strategy adopted for the solution have been given in **Chapter 1**. Literature Review undertaken to study the latest work done on the problem defined in current work, is compiled in **Chapter 2**. Details of VC++, 3DS Max and Virtual environment used in current work have been given in **Chapter 3**. **Chapters 4 and 5** give details of developed software on Pushover Analysis and structural aspects of evaluation of loads, design, retrofit and virtual world for earthquake forces. **Chapter 6** describes in detail all aspects of structural design and mitigation of cyclone forces. **Chapter 7** describes virtual reality aspects of cyclone forces. **Chapter 8** gives the structural aspects for mitigation of disaster due to fire. Whereas **Chapter 9** describes structural aspects for flood control. Structural aspects of blast loads and tsunami are detailed in **Chapter 10**. Finally **Chapter 11** highlights the conclusions and contributions of this work along with future scope.