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It is further certified that the student has fulfilled all the requirements of Comprehensive Examination, Candidacy and SOTA for the award of Ph.D. Degree.

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I, **NARAYAN** (Roll Number 17061003), certify that the work embodied in this thesis is my own bona fide work and carried out by me under the supervision of **PROFESSOR KRISHNA KANT PATHAK** from **2017** to **2021**, at the **DEPARTMENT OF CIVIL ENGINEERING**, Indian Institute of Technology (BHU), Varanasi. The matter embodied in this thesis has not been submitted for the award of any other degree/diploma. I declare that I have faithfully acknowledged and given credits to the research workers wherever their works have been cited in my work in this thesis. I further declare that I have not willfully copied any other's work, paragraphs, text, data, results, etc., reported in journals, books, magazines, reports dissertations, theses, etc., or available at websites and have not included them in this thesis and have not cited as my own work.

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Dedicated to

My Family and Almighty God

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Symbols/ Abbreviations have been explained wherever they appear first in a Chapter

PREFACE

For many years, structural engineers have been constructing the steel braced frames in the form of buildings/towers, sub-structure frames to support water tanks, pedestrian bridges over roads/ railway lines or the steel truss bridges etc. Older conventional steel braced frames are present in many of the developed/ developing country. With time, some of them became obsolete for further use because of not being able to satisfy the current codal provisions. The favourable thing about the functional older steel braced frame structures would be their design procedures that were very conservative (*factor of safety was high*) while designing the critical components. So, only few members could not comply to the current seismic provisions. The most severe problem identified in almost all of these steel braced frames has been the buckling of their members. Buckling causes sudden loss of strength of the buckled members; overall effect of which on the structure can be severe. The steel braced frames that were constructed before the development of the current seismic provisions (*pre-1988*) have been referred as the non-ductile conventional steel braced frames, non-ductile concentric steel braced frames or the non-seismic steel braced frames (*generally*, *called as 'NCBFs'*).

Rather than doing retrofitting after any natural calamity, doing renovation suits perfect with the famous saying "Prevention is Better than Cure". Most of the currently available methods for the retrofitting of NCBFs have been found to be disruptive to the occupants, required serious structural interventions and complete replacements of many members. The renovation strategies devised here would prove to be economical (*low requirement of material, time and labour*), least destructive (*minimal structural/ architectural intervention and least disruptive to the occupants*) and yet structurally sound (*the detrimental effects of buckling of the members were significantly minimized*).