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Derivation of Empirical Formula of Natural Period for Irregular Building with Shearwall

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ABSTRACT: In Indian standard seismic code IS – 1893 (Part-1): 2016 provides a guideline to calculate natural time period of building with shear-wall for static analysis. In this paper, an attempt has been made to find the natural time period for Irregular building with shear wall and to develop a formula to calculate natural time period of building with shear-wall. In this paper multi-storied RC frame Irregular building with different plans, different shape of columns, different floor heights and different building heights with different lengths of shear-wall along with brick masonry infill panels has been considered.. All the buildings have been analyzed and designed as per IS Codes. Dynamic analysis has been performed using ETABS software and the natural time period of fundamental mode has been evaluated. Based on natural time period results the new formula for a Derivation of natural time period of the building has been proposed by a method of regression analysis with Microsoft-Excel.

KeyWords: NaturalPeriod;IrregularBuilding;Height ;RC; MRF

I. INTRODUCTION

Earthquakeshakingisrandomandtimevariant .Butmostdesigncodesrepresenttheearthquakeinduced inertiaforcesastheneteffectofsuchrandomshakinginth eformofdesignequivalentstaticlateralforce.Thisforcei scalledastheSeismicDesignBaseShearVBandremain stheprimaryquantityinvolvedinforce-basedearthquake-resistantdesignofbuildings.Thisforcedependsonthese ismichazardatthesiteofthebuildingrepresentedbytheS eismicZoneFactor

Z. Also,inkeepingwiththephilosophyofincreas ingdesignforcestoincreasetheelasticrangeofthebuildi ngandtherebyreducethedamageinit,codestendtoadop ttheImportanceFactorIforeffectingsuchdecisions.Fur ther,thenetshakingofabuildingis a combinedeffectof theenergycarriedbythe Earthquakeatdifferentfrequenciesandthenaturalperio dsof thebuilding.

Thefundamentalperiodofabuildingisakeypa rameterfortheseismicdesignofabuildingusingtheequi valentlateralforceprocedure.Thelinearstatic(orlateral force)methodallowsengineerstopredictthefundament alperiodofvibrationinasimplifiedmannerandcalculate thedesignbaseshearforceMostoftheseismiccodeprovi defundamentaltimeperiodformulaforRCmomentresi stingframes,SteelMRF,RCmomentresistingframeswi thorwithoutshearwall,SteelMRFwithorwithoutshear wallalongwithincludingtheeffectofinfillpropertiesan dwithoutinfillproperties.Indianseismiccodeprovideg uidelinetocalculatefundamentalperiodofbuildingwit hshearwall,TheformulagiveninIndiancodeforallother generalstructurespredictverylowervalueof timeperiod.

1.1OBJECTIVE

Themainobjectivesofundertakingthepresentstudyare asfollows:

- Comparativestudyofnaturalperiodbasedonstati canddynamicanalysisforregularandirregularbui ldingswithshearwall.
- Tostudytheeffectheightofbuilding,Shearwalldi mensionandplanirregularitieson naturalperiodofbuildings.
- Toderivetheformulaofnaturalperiodforregulara ndirregularbuildingswithshearwallbasedondyn amicanalysisusingregressionanalysis.

1.2 SCOPE

- Thenumericalinvestigationiscarriedoutfors ymmetricandasymmetricbuildingswithshearwall.Th

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emulti-storiedregularandirregularbuildingswithdifferentplanconfigurationandbuildingheightwithshearwallisconsidered.Ithisnumericalstudy,thebuildingshavebeenconsideredstartingfromG+4storiedtoG+20storied.

- Allthebuildingsaredesignedasper Indiancodaprovisions.
- Thisnumericalinvestigationisdonealongwithbrickmasonryinfillpanelsofmulti-storiedbuildingwithshearwall.
- Thedynamicanalysisofallthebuildingsiscarriedoutusing ETABSandtheequationfornaturalperiodisderivedbymethodofregressionanalysisusing IBM-SPSS.
- Aformulafor calculatingthenaturalperiodofbuildingwith shearwall isproposedand accuracyofthatformulahasbeenchecked

II. LITERATUREREVIEW

[1]Chotaliyaetal.(2018)It is seen that the natural period given byload has value lesser than natural period obtain by dynamic analysis. Natural period is less than sa/g will be higher and due to that seismic effect Ah will be higher if Ah will higher than the value of base shear Vb will be high and as a result the structure need to design for higher force .

It makes uneconomical structural design. In the present research work the formula has been developed which will give natural time period directly, otherwise it is obtained by dynamic analysis

[2]Loghmani(2021)One of the most important structural characteristics is the fundamental vibration period, which is largely determined by the inherent properties of the structure. Seismic codes and some researchers use the number of stories or the total height of a building to estimate fundamental vibration periods experimentally and mathematically. The results of evaluating various relationships are based on structure height, mass, stiffness and number of stories. Since the overall height and number of floors do not differentiate between regular and irregular structures, the mass and stiffness of each floor appear to be so important in the region of the building's vibration cycle. Considering the importance of irregular buildings, a new relationship is proposed to determine the fundamental natural vibration period of highly elastic regular and irregular buildings using artificial neural networks. The accuracy of the proposed relationship is perfectly validated and numerically validated

[3]GoelandChopra(1997,1998)Evaluating the formula specified in the current U.S. code using available data on the fundamental period of the building "measured" by the motion of the building recorded during eight California earthquakes, the results show that the current code for estimating the fundamental period of RC and steel MRF buildings The formula improves the correlation with the measured data better. Subsequently, an improved formula was developed by calibrating the theoretical formula through regression analysis.

[4]VelaniandRamancharla(2017)This is a study of the reliability of empirical expressions in the fundamental period of tall buildings in India. To this end, we conducted ambient vibration tests in 21 RC buildings in the cities of Mumbai and Hyderabad, placing vibration sensors on the uppermost accessible floors. The time period of measurement has been compared with the code provisions. The study found that as the height of the building increases, the natural cycle does not scale linearly with height; instead, it becomes flexible.

[5]KewateandMurudi(2018)A review of previous literature shows that the expressions proposed by the code are based on regression analysis performed on a dataset consisting of experimentally determined periods of a few buildings located in an area. An extensive literature review suggests that the code restrictions for this period were too conservative. The database must have been expanded to include results from new seismic data.

III. CONCLUSIONS

FromtheaboveresearchpaperitispossibletoanalyzetheirregularBuildingwithshearwallinetabsoftware.DerivationofempiricalformulaofnaturalperiodthroughregressionanalysisusingMicrosoftExcel.Establishnewrelationbetweenirregularity and Naturalperiod.

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