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| **Activity 3.2.10 Keystone Library Spread Footing Analysis** |

Introduction

During the engineering investigation of the existing facility on the Keystone property, the engineer noted that the estimated allowable soil bearing pressure for the footings is 3500 psf based on a soil analysis and level of compaction under the building. Although the existing footings are sound and show no distress, the engineer recommended that the footing size be checked based on the new library loads to ensure that the existing foundation is adequate.

In this activity you will check the existing footings for adequacy. Now that you have determined the design loads for the roof and the 2nd floor, you can chase the loads to the columns and calculate the resulting soil bearing pressure. If the existing footings are inadequate, you must indicate the new foundation design requirements on the construction drawings.

Equipment

* Keystone Library Renovation Preliminary (student version).rvt
* Keystone Library Spread Footing Analysis Check Sheet

Procedure

1. Analyze the existing interior spread footings for the Keystone Library Renovation to determine if they are adequate to carry the new design loads. Consider three cases.

* Columns on column line 2 will carry the green roof only.
* Columns on column line 3 will carry green roof loads, upper roof loads, and 2nd floor loads.
* Columns on column line 4 will carry upper roof loads and second floor loads.

Do not analyze the combined spread/continuous footings that support the exterior wall and columns.

In order to perform the analysis, you must determine the column load imposed by the roof and/or floor(s) for each column. The loads from the green roof and/or 2nd floor can be determined based on the beam and girder end reactions (see **Activity 3.2.7**). The load imposed by the upper roof can be estimated by using roof design load and the tributary roof area that contributes load to each column (see **Activity 3.2.2**).

1. Check a classmate’s calculations. Document your assessment on the **Keystone Library Spread Footing Analysis Check Sheet** and sign the form. As the checker, you assume responsibility that the design is adequate and meets code requirements.
2. Make necessary corrections to your calculations based on your classmate’s assessment. Once you have made the necessary corrections and you both agree that the calculations are correct and that an adequate design has been selected, obtain your teammate’s signature on every page of your calculations.
3. Revise your Keystone Library Renovation 3D model to reflect your footing analysis. Dimension and annotate the foundation plan, as necessary, to indicate any renovations that are required per your calculations.

Criteria

* Assume that the green roof loading is equivalent to the 2nd floor loading.
* The thickness of any new footings must match the thickness of the existing footings.
* If footing sizes must be increased, add concrete in one direction such that the footing will be rectangular.

Deliverables

1. **Hand calculations** for *each* case to show whether or not the existing footing is adequate. If the existing footing is inadequate, specify an acceptable footing size. For simplicity, neglect the weight of the column(s) in your calculation(s).
2. A **Keystone Footing Design Check Sheet** completed and signed by a classmate.
3. A copy of your Keystone Library Renovation FOUNDATION PLAN with annotation to show foundation renovations, as necessary.

2nd floor interior beam end reaction = 25800lb

2nd floor exterior girder end reactions= 51600 lb

Therefore, column load from the 2nd floor/green roof for all interior columns is; p 2nd = 2(25800 lb)+2(51600 lb)=154800 lb Tributary roof area (col line 3)= ½ (30ft)x (24ft)=360ft2 Tributary roof area (col line 4)= (30ft)x(24ft)=720 ft2 Upper roof dead+ live load (from activity 3.2.2) =50 psf Proof (col line 3) = (360ft^2) (50 lb/ft^2)= 18000 lb Proof (col line 4)= (720ft^2) (50 lb/ft^2)= 36000lb Therefore the column load are P(col line 2) = 154800lb P(col line 3)= 154800lb + 18000lb=172800lb P(col line 4)= 154800lb + 36000lb=190800lb Determine net allowable soil bearing pressure The existing footing thickness is 2 feet. Reduce the allowable soil bearing pressure to account for the footing weight.

Pfooting = tfooting x 150 lb/ft^2

Pfooting= (2ft) x 150 lb/ft^2= 300lb/ft2

Lnet= fallow – Pfooting

Lnet= 3500psf-300psf=3200psf

A>Pcol/lnet

Determine existing footing area A=(7ft)(7ft)=49ft^2

Interior footing on columns line 2 A>154800lb/3200 lb/ft^2= 48.8ft^2 A=49ft^2 >48.4ft^2

The existing footing is adequet for interierior footings on column line 2

Interior footings on column line 3 A> 172,800lb/3200 lb/ft^2=54ft^2

Determiner the net allowable soil nearing pressure the existing thickness is 2 feet. Reduce the allowable soil bearing pressure to account for the footing weight.

Conclusion

1. As the design engineer for this Keystone Library Renovation Project, describe in detail the adequacy of the existing foundation system to carry the design loads for the new library renovation.

The existing foundation has to be able to support the load of what’s being built on otherwise itd would just have to be torn down completely and start over which would require a lot more time money and resources