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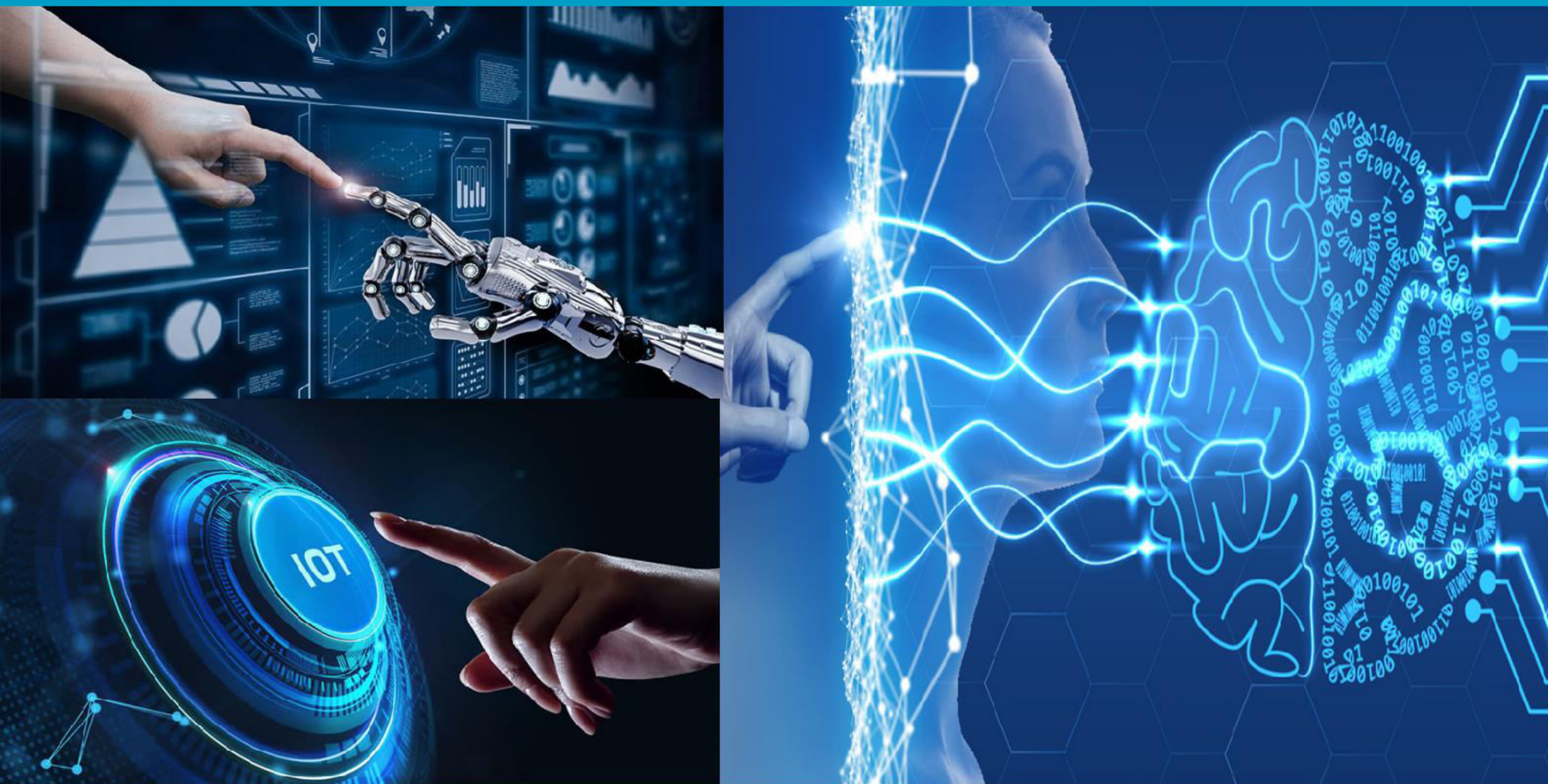

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Structural Analysis of Fundamentally Projection Bridges Using EPS Geofoam as Backfill

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ABSTRACT: Projection bridges are preferable than regular ones in several ways. This implies fewer or no bridge joints and less direction. Both reduce creation and maintenance costs. A structure with fewer heads and joints will also require less support. Because of these reasons, many companies employ projection bridges wherever possible. In medium seismic zones, additional seismic stacking projection bridges are being built. Bridges with projections are stiffer than those without. The superstructure is solidly linked to the projection. Greater inflexibility may draw additional forces when building for seismic stacking. This may prohibit using bigger areas, which increases labor and material costs. It would be great to be able to build less-hardened projection bridges, which would reduce the seismic strain on certain components. EPS Geofoam may make basic projection bridges less solid when used as backfill. This may minimize projection strengths during earthquakes and make the bridge more flexible.EPS Geofoam backfill reduces minute and shear inside essential projections. Usually true for hard, medium-hard, and soft sand and hard, medium-hard, and soft clay in piles. Both Bridge A and B seemed similar. EPS Geofoam backfill allows essential projections to move more than if compressed. This slightly moves the wharf. Seismic stacking moves the important projections and central dock somewhat. The minor amount of new growth may be included in the forecasts and wharf plan. This little amount of additional displacement reduces seismic minutes and shears, which is a huge gain. It's simpler to develop basic forecasts with fewer strengths to consider. Smaller cross-sections may result. In addition, reducing the minute in basic predictions minimizes the total rotation that must be planned for during a seismic event. When EPS Geofoam backfill is used instead of compacted backfill, dock cap and modify powers don't affect the structure as a whole. This increase doesn't help or hinder the structure as a whole; it's likely a secondary consequence of EPS Geofoam back fill's other advantages. Planning bridges for seismic loads in a direct seismic zone requires predictions, especially with EPS geofoam backfill. Even though these models' core predictions brought in more seismic force than the usual seat-type projections, these extra powers were nonetheless predictable. With EPS geofoam backfill and basic abutments, there are fewer joints and heading, which reduces support, review, and repair costs. It may have lower initial development costs than estimates with compacted backfill since plan strengths are lower, making them smaller. EPS geofoam may save money on fabric and installation expenses, but it can also make construction more expensive.

KEYWORDS: Integral abutment bridges (IABs), Projection of Bridges, EPS Geofoam as backfill

I. INTRODUCTION

Integral abutment bridges (IABs), which may have as many as 13,000 in operation in 2005, have become more and more popular recently, according to a Federal Highway Administration survey. (P.E. Maruri and P.E. Petro) Given the numerous benefits integral proximate bridges have over derivational bridges—advantages that will be covered in more detail in this division—this growing trend makes sense. Despite a recent rise in the number of IAB construction projects, little information exists concerning their seismic presentation. The goal of this research is to better understand the seismic presentation of integrated proximate bridges with compacted versus expanded polystyrene geofoam base material in various configurations. To completely comprehend integral abutment bridge behaviour, it is necessary to comprehend how traditional bridges and integral abutment bridges differ from one another. Conventional or jointed bridges, as depicted in Figure 1, feature at least one flexibility and versatility and bearings at either end to provide little vibration in the superstructure and substructure. Rather than wheels, there are bearings. In this instance, the superstructure and the substructure are interconnected. Figure 2 depicts integrated abutment bridges, which differ from conventional bridges in that they lack expansion joints and bearings at their ends. As opposed to that, the abutments and girders are built together, or smoothly.

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II. FINITE ELEMENT MODEL

As we've as of now talked approximately, distinctive models are made to figure out how necessarily projections influence a bridge's reaction to seismic tremors. For this think about, each bridge was spoken to by a add up to of 13 models. The primary show for each bridge is the ordinary jointed bridge, in which the projections are treated as underpins and no SSI is accepted, which can be talked approximately in more detail afterward. This show was utilized as the control for each of the bridges. The comes around of these two control models were compared to the comes around of a apportioned appraisal of these bridges in their "as-built" state.The comes about of these two control models were compared to the comes about of a partitioned assessment of these bridges in their "as-built" state. The projections on the other 12 of the 13 bridge models are built in, whereas the projections on the primary show were made independently. The as it were things that are diverse between these 12 models are the backfill for the projection heaps and the properties of the soil where the projection heaps are built.

The heaps contained thick sand, medium thick sand, free sand, solid clay, and medium clay. In the same way, the in-situ soil type for each of the six IAB models with EPS geofoam backfill is either thick sand, medium thick sand, free sand, solid clay, medium solid clay, or soft clay. In each case of a single bridge, Table 6 shows howthe backfill surface and soil around the loads support the projections. IAB 2015 Alteration 17.1.1 Progressed with Rating to make all of the models for the limited parts of these bridges.

The outline components, shell components, connect components, and hubs were utilized to put these models together. The Bridge Wizard instrument was utilized to create the common shape of each bridge (see Figure 12). There was thought given to the vertical and even formats, deck widths, span lengths, brace dividing, stomach areas, and wharf formats. The Bridge Wizard was moreover utilized to set the thickness of the deck, the point of the docks and projections, and the remove between the dock columns. It was too utilized to set the properties of the braces, the dock cap, and the columns. All the changes to the indispensably projections, their supporting heaps, and the dock soil were made by hand.

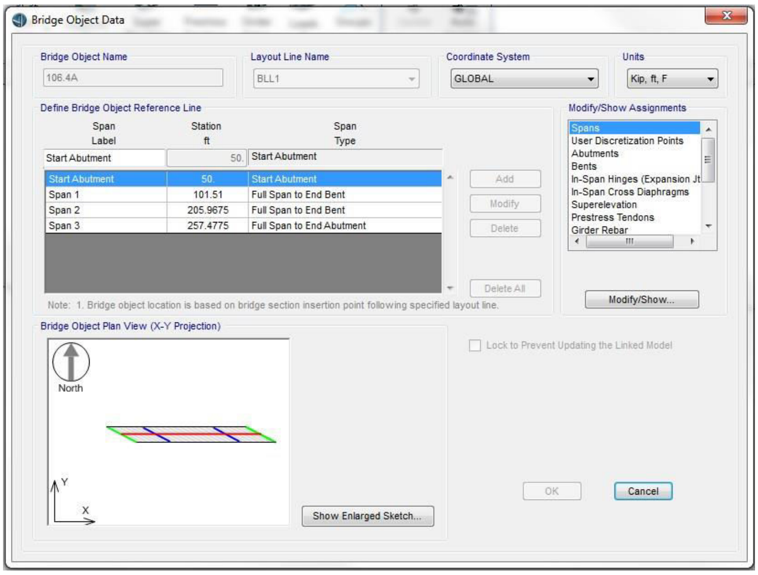

Fig. 1: Bridge Wizard Device (computers and Structures, Inc.)

Structure Modelling

The superstructure was displayed in three steps. the deck, the supports, and the stomachs. Figures 13 and 14 appear how the "Superstructure – Deck Segments" device was utilized to depict the deck. With this IAB definition device, the client can set the taking after subtle elements.

• How enormous is the deck?

• How thick the deck is

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- The number of braces as a whole
- Dispersing between supports is important.
- Sizes of awnings

With the "Bridge Wizard" apparatus, the "Superstructure – Deck Areas" definition tool's deck areas were put on the correct ranges. The supports and diaphragms were set up with the assistance of a device called Wizard.

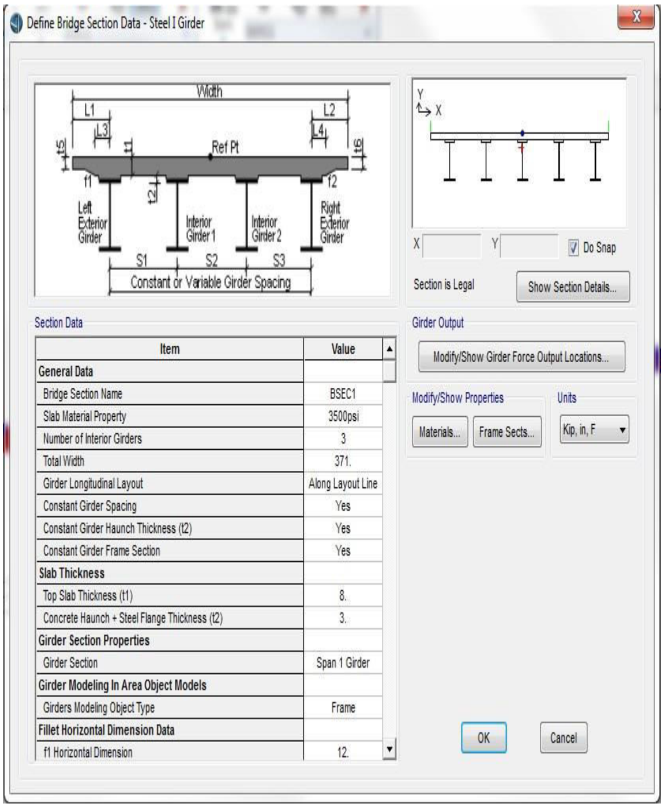

Fig. 2: Deck segment Definition Instrument for Steed Super structure

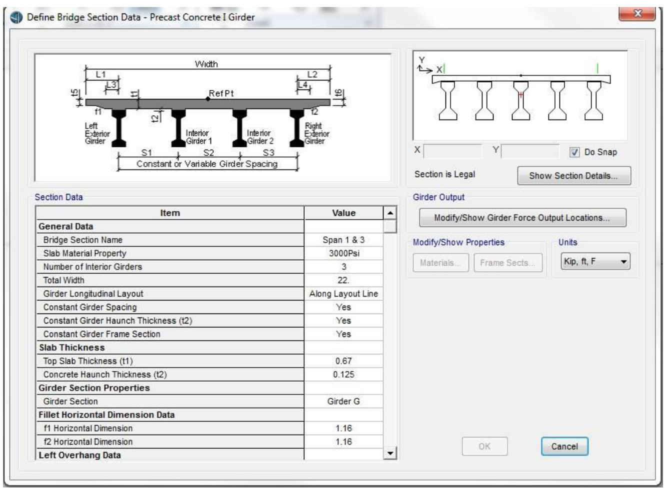

Fig. 3: Deck segment Definition Instrument for Concrete Super structure

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III. RESEARCH ANALYSIS

Most of the time, both time history investigation and multi-modal reaction range examination (RSA) are utilized to see at how bridges respond to seismic tremors. The multi-modal RSA is thought to be a more refined investigation than the time history examination since it can provide preservationist comes about. Individuals think that the multi-modal RSA is more traditionalist than a time history investigation. Usually ordinarily sufficient for numerous ventures. Time history investigation is as a rule as it were utilized when more exact comes about are needed or when the traditional way the multimodal RSA taken anymore The multi-modal RSA was chosen to be used for all 13 models of each bridge in this parametric consider because it is flexible and meets the current Bridge Plan Details of the Indian Affiliation of State Thruway and Transportation. Also, the multi-modal RSA gives results for a more common seismic event because it is based on several plan seismic tremor time history records and takes a bit more work to show and test, it was decided that the information didn't need to be improved any further. The multi-modal RSA will give accurate results that can be used to figure out how different factors affect how bridges react to seismic tremors. Based on what this parameter considers, there are a few more changes that can be made.The comes about of the time history investigation do not need to be utilized with the multi-modal RSA. So, multi-modal reaction range investigation was utilized in this studyConcurring to the AIIMS Flyover Bridge Plan Details, bridges must have a moo chance of falling down when the ground shakes from an seismic tremor with a 7 percent chance of happening each 75 a long time. This implies that it'll come back in 1000 years. So that 90% of the populace might take portion in each demonstrate, the proper number of modes had to be made. The bridge's scope and longitude, as well as its top ground speeding up (PGA), brief period seismic parameter (SDs), and 1-second period seismic parameter (SD1), were entered into IAB. The BRIDGE Risk Maps were at that point utilized to make the reaction spectra. Figures 34 and 35 appear the reaction spectra for each bridge. The input reaction range was utilized to characterize the modular stack case in IAB, which employments the eigenvector modular sort rather than the Ritz vector examination. Eigenvector examination is utilized to figure out the system's characteristic modes, which are the shapes and frequencies of its undampened free-vibration modes. These donate data almost how the structure carries on (Computers & Structures, Inc.). Ritz vector examination is an alternative to eigenvector investigation that's utilized when managing with modular data. In this parametric ponder, not one or the other superposition nor time-history investigation can be utilized to see at the models.

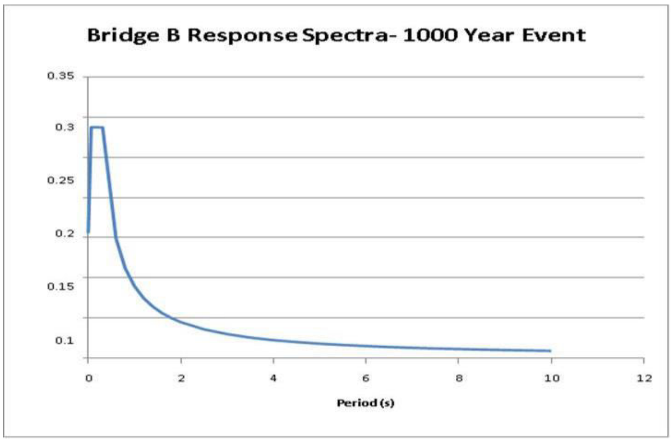

Fig. 4: Bridge B Reaction Spectra

IV. ANALYSIS RESULTS

ANALYSIS

In each demonstrate, diverse estimations are utilized to figure out how the bridge reacts to seismic tremors as a entire. This incorporates the flat and vertical development of the best of the dock, the best of the necessarily projections and the ordinary projections, and the foot of the necessarily projections. Since ordinary projections are not displayed in their aggregate, relocations at the foot of the projections are not known based on the displaying suspicions. See Area 2.3.2 more about how the projections are shown. Other measurements include the greatest minutes and shears of the wharf column, cap, and balance, as well as the base responses and mode shapes.

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Period for Structural

The most auxiliary period of the bridge could be a coordinate reflection of how solid it is as a entire. The prevailing period of a structure is longer the more adaptable it is. The adaptability of the structure influences how the loads are spread between the docks and projections. Table 23 appears the fundamental auxiliary period for each show. The letters (CB) or (EPS) after the demonstrate number appear that the show is for an IAB with compacted backfill or an IAB with EPS geofoam backfill, separately. In Table 1, you'll see a list of the basic periods. The ordinary bridge with joints is the foremost adaptable and has the longest prevailing basic period. The IAB show with The most flexible is EPS Geofoam backfill and soft clay at the piles. The IAB show with compacted backfill and hardened clay at the heaps is the stiffest and has the quickest . The majority of the basic time periods of each show that EPS geofoam backfill makes the structure more flexible than compacted backfill. Mode shapes are also used to figure out how strong a bridge is and how it responds to earthquakes as a whole…

The bridge's most important mode shape is the primary mode shape. Figures 36–41 appear the primary mode shape for each conventional jointed bridge show, the IAB demonstrate with.

Table 1: fundamental period

Model Number	Model Description	Structural Period	
		Bridge A	Bridge B
1	Jointed Bridge	1.555	1.213
2 (CB)	Dense Sand	0.812	1.079
3 (CB)	Medium Dense Sand	0.815	1.086
4 (CB)	Loose Sand	0.820	1.087
5 (CB)	Stiff Clay	0.752	1.045
6 (CB)	Medium Stiff Clay	0.799	1.073
7 (CB)	Soft Clay	0.842	1.093
8 (EPS)	Dense Sand	1.226	1.118
9 (EPS)	Medium Dense Sand	1.242	1.126
10 (EPS)	Loose Sand	1.274	1.127
11 (EPS)	Stiff Clay	0.988	1.074
12 (EPS)	Medium Stiff Clay	1.167	1.110
13 (EPS)	Soft Clay	1.417	1.136

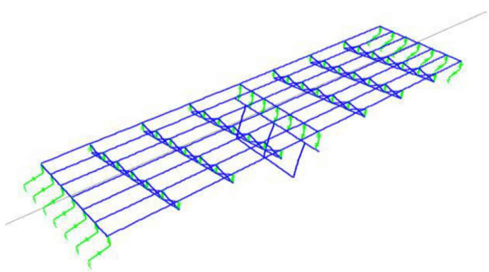

Fig. 5: Mode shape for Bridge A with Ordinary projection

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PIER And Projection Uprooting

The longwise and crosswise development of the docks and projections are critical parts of figuring out how the structure will respond to a shudder. The sum of development that docks and projections can handle in either course is limited. Traditional seat-type projections do not exchange most of the development to the projections themselves since the heading take up most of the development. Indispensably projections are made to permit for a certain sum of development to account for the superstructure's development and withdrawal due to changes in temperature. Be that as it may, they are not more often than not made to permit for a parcel of development due to an seismic tremor. So, the development in each model's projections can be utilized to figure out the most excellent backfill and soil combination for indispensably projections beneath seismic loading. Like projections, docks can as it were handle a certain sum of uprooting. Docks in IABs can move more than docks in conventional bridges since the structure is stiffer. Since of this, it is exceptionally critical to figure out how much the dock moves for any combination of projection backfill and soil at the piles. The longitudinal and transverse wharf relocations measured at the dock cap are appeared in Tables 2 and 3. Relocations of indispensably projections are measured both at the best and at the foot of the projection. The weight is given in kilogrammes.

Table 2: Bridge A Longitude and Traverse Pier Displacement

Model Number	Model Description	Longitudinal Displacement (in)	Transverse Displacement (in)
1	Jointed Bridge	-0.190	0.690
2 (CB)	Dense Sand	-0.474	0.250
3 (CB)	Medium Dense Sand	-0.475	0.253
4 (CB)	Loose Sand	-0.476	0.260
5 (CB)	Stiff Clay	-0.464	0.191
6 (CB)	Medium Stiff Clay	-0.472	0.256
7 (CB)	Soft Clay	-0.481	0.289
8 (EPS)	Dense Sand	-0.482	0.365
9 (EPS)	Medium Dense Sand	-0.483	0.374
10 (EPS)	Loose Sand	-0.485	0.390
11 (EPS)	Stiff Clay	-0.469	0.234
12 (EPS)	Medium Stiff Clay	-0.479	0.332
13 (EPS)	Soft Clay	-0.494	0.432

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Table 2: Bridge B Longitude and Traverse Pier Displacement

Model Number	Model Description	Longitudinal Displacement (in)	Transverse Displacement (in)
1	Jointed Bridge	0.838	0.183
2 (CB)	Dense Sand	-0.666	-1.969
3 (CB)	Medium Dense Sand	-0.666	-1.969
4 (CB)	Loose Sand	-0.611	-1.754
5 (CB)	Stiff Clay	-0.625	-0.222
6 (CB)	Medium Stiff Clay	-0.628	-0.249
7 (CB)	Soft Clay	-0.632	-0.271
8 (EPS)	Dense Sand	-0.670	-1.965
9 (EPS)	Medium Dense Sand	-0.670	-1.966
10 (EPS)	Loose Sand	-0.670	-1.966
11 (EPS)	Stiff Clay	-0.625	0.278
12 (EPS)	Medium Stiff Clay	-0.628	-0.340
13 (EPS)	Soft Clay	-0.633	-0.488

V. CONCLUSION

Fundamentally projection bridges are way better than conventional projection bridges in numerous ways. This implies that there are less or no bridge joints and less orientation. Both of these spare cash on development and upkeep costs. Also, a structure with less heading and joints will require less support over its lifetime. Because of these stars, numerous associations are pushing to utilize fundamentally projection bridges at whatever point they can. Since of this, more necessarily projection bridges in medium seismic zones are being made for seismic stacking. Because the superstructure is connected to the projection in a solid way, bridges with projections tend to be more rigid than bridges with regular projections. When planning for seismic stacking, this additional inflexibility can make the structure draw in more strengths, which may cruel utilizing bigger areas, which costs more in work and materials. It would be great to be able to form necessarily projection bridges less hardened and, in turn, reduce the stack that seismic tremors put on certain parts. Utilizing EPS Geofoam backfill with fundamentally projection bridges can have numerous points of interest, such as making the bridge less solid. This may offer assistance diminish the strengths on the projections amid seismic tremors and make the bridge more adaptable as an entirety.

When compared to compacted backfill, EPS Geofoam backfill diminishes both the minute and shear within the indispensably projections. Usually genuine for all sorts of sand and clay at heaps, counting difficult, medium-hard, and delicate sand and difficult, medium-hard, and delicate clay. Both Bridge A and Bridge B appeared this to be true. EPS Geofoam backfill lets the indispensably projections move a small more than they would in the event that the backfill was compacted. In turn, this causes the wharf to move a small bit more. A satisfactory side impact of seismic stacking is that the indispensably projections and central dock move a small bit more. The small sum of additional development can be taken into consideration within the plan of the necessarily projections and wharf. This is little sum of expanded relocation, on the other hand, makes it conceivable to decrease the minutes and shears within the projections under seismic loading, which could be an enormous plus. This makes it easier to design the fundamentally projections since there are less strengths to require into consideration. This might lead to littler cross-sections. Moreover, the reduction in minute within the fundamentally projections is imperative since it reduces the sum of revolution that the necessarily projection must be designed for amid a seismic event. When EPS Geofoam backfill is utilized rather than compacted

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backfill, both the increase in dock cap powers and the increase in dock adjust powers do not have a huge effect on the structure as an aggregate. This increase doesn't offer help or hurt the structure as an aggregate; it's reasonable a side effect of the other benefits that come from utilizing EPS Geofoam backfill instead of compacted backfill. When planning bridges for seismic loads in a direct seismic zone, indispensably projections are a great choice, particularly when matched with EPS geofoam backfill. Indeed, in spite of the fact that the fundamentally projections in these models pulled in more seismic constrain than the conventional seat-type projections, these additional powers were still inside a run that may well be outlined for. With this combination of EPS geofoam backfill and fundamentally abutments, there are less joints and heading, which could be a great thing since it brings down the taken a toll of support, review, and repair. It might moreover have lower starting development costs than necessarily projections with compacted backfill since the plan strengths within the projections are lower, making them smaller. Even in spite of the fact that EPS geofoam can spare cash on fabric and establishment costs, it can moreover make it more costly to build.

REFERENCES

1. American Institute of Steel Construction (AISC). Manual of Steel Construction, 14th Edition.
2. Chicago, IL, 2011.
3. Albhaisi, Suhail M. and Hani Nassif. "Effect of Substructure Stiffness on the Performance of Integral Abutment Bridges Under Thermal Loads." (2012). 325.
4. Indian Association of State Highway Transportation Officials. BRIDGE LRFD Bridge Design Specifications, Sixth Edition. Washington, D.C., 2012.
5. Bowles, J.E. Foundation Analysis and Design, 5th Edition. New York, NY. McGraw-Hill, 1996. —. IAB 2015 Advanced w/Rating Version 17.1.1 Build 1099. 2014.
6. Dicleli, Murat, P. Eng and M. Suhail Albhaisi. "Maximum Length of Integral Bridges Supported on Steel H-Piles Driven in Sand." Elsevier (2003). 14.
7. Clough, G. W. and J. M. Duncan. "Earth Pressures." Fang, Hsai-Yang. Foundation Engineering Handbook. Springer, 1991. 923.
8. Computers & Structures, Inc. CSI Analysis Reference Manual for SAP2000, ETABS, SAFE and IAB. Berkeley, California, 2014.
9. Dombroski, Jr., Daniel R. "Earthquake Risk in New Jersey." 2005.
10. Expanded Polystyrene Data Sheet. 2015. 15 August 2015.
11. <http://universalconstructionfoam.com/resources/expanded-polystyrene-data- sheet.php>.
12. Frosch, J. Robert, et al. "Jointless and Smoother Bridges. Behavior and Design of Piles." Perdue University, 2004.
13. Geofoam Applications and Uses. 2015. 2015. <http.//www.geofoam.com/applications/>. Insulated Building Systems. "GeoTech TerraFlex Product Specifications." n.d.
14. "Integral Abutment and Jointless Bridges." The 2005 - FHWA Conference. Baltimore, MD. Federal Highway Administration, 2005. 343.
15. Iowa Department of Transportation, Office of Bridges and Structures. "Commentary Appendix for Technical Documents." LRFD Bridge Design Manual Commentary. 2009.
16. Kafka, Alan L. Why Does the Earth Quake in New England? 15 February 2014. 3 June 2015.
17. <http://universalconstructionfoam.com/resources/expanded-polystyrene-data- sheet.php>. Kratzer Environmental Services. "Physiography, Topography and Geology." 2006.
18. Maruri, P.E., Rodolfo F. and Samer H. Petro, P.E. "Integral Abutmetns and Jointless Bridges (IAJB) 2004 Survey Summary." The 2005 - FHWA Conference. Integral Abutment and Jointless Bridges (IAJB 2005). Baltimore, MD. Federal Highway Administration, 2005. 19.
19. Matlock, H. "Correlation for Design of Latterally Loaded Piles in Soft Clay." Proceedings of the II Annual Offshore Technology Conference. Houston, Texas, 1970. 577-594.
20. New Jersey Department of Transportation. Design Manual for Bridges and Structures. 2009. Rees, L.C. and W.F. Van Impe. Single Piles and Pile Group under Lateral Loading. Rotterdam. A.A.
21. Balkema, 2001.
22. Skempton, A. W. "The Bearing Capacity of Clays." Building Research Congress. London, England, 1951. 180-189.
23. Volkert, Rich. "Geology of the Piedmont Province (Newark Basin)." 2008. Rutgers. 15 May 2015. <http://envirostewards.rutgers.edu/Lecture%20Resource%20Pages/2008Lecture%20No tes/ECEC%20Piedmont%20geology.pdf>.
24. Witte, Ron W. and Don H. Monterverde. "Geologic History of New Jersey's Valley and Ridge Physiographic Province." New Jersey Geolofical and Water Survey Information Circular 2012. 8.

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| DOI: 10.15680/IJMRSETM.2022.0908008|

25. United States Geological Survey. New Jersey 2014 Seismic Hazard Map. 30 October 2014. 15 May 2015. <http.//earthquake.usgs.gov/earthquakes/states/new_jersey/hazards.php>.- New Jersey Earthquake History. 14 January 2015. 15 May 2015.
26. <http.//earthquake.usgs.gov/earthquakes/states/new_jersey/history.php>. New Jersey Seismicity Map - 1973 to March 2012. 18 April 2014. 15 May 2015. <http.//earthquake.usgs.gov/earthquakes/states/new_jersey/seismicity.php>.

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