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Applications of Fly Ash and Analysis and Design of Fly Ash Brick

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Abstract- ***Today's industry is striving for better and economic construction material. Fly Ash is one of such material which is obtained as waste material in thermal power plants. Fly Ash brick is one of product made by using Fly Ash. In this article three design of Fly Ash brick using standard size 190X90X90mm for different cross-sectional area is studied using Ansys design tool. In first type of Brick used dimension according Indian standard. From second type of brick, two cubical shape volume is removed and in third type of brick, two cylindrical shape volume is removed. It is found that third (C) type of brick is superior for safety and economic purpose. Fly Ash brick is lighter in weight and have more strength in comparison to clay brick also and it utilizes waste material released in thermal power material in beneficial ways which is good for environment.***

1-Introduction

Fly Ash is generated as waste material in thermal power plants, Fly Ash is responsible for water pollution, air pollution, and adverse effect on agriculture land and also hazardous for human health so if Fly Ash is released directly into environment it causes many problems to flora and fauna. So it is necessary to use Fly Ash in beneficial ways, many researchers have suggested different ways of using Fly Ash, one of its use is as Fly Ash brick. Fly Ash material enhance durability of concrete through control of high thermal gradient. Fly Ash brick is lighter in weight and have more strength in comparison to clay brick also and it utilizes waste material released in thermal power material in beneficial ways which is good for environment.

2- Methodology

Firstly goal of study is figured out, it is found that not much work has done on the study of cross-section area of Fly Ash brick. For study purpose 3D model of brick is created on Ansys workbench 15.0 version, for study purpose boundary condition constraint and forces is applied for each three design. 3D modeling is the process of designing any object by use of available tools in 3D space. 3D object is created by using geometrical tool and manipulating it as the designer intends.

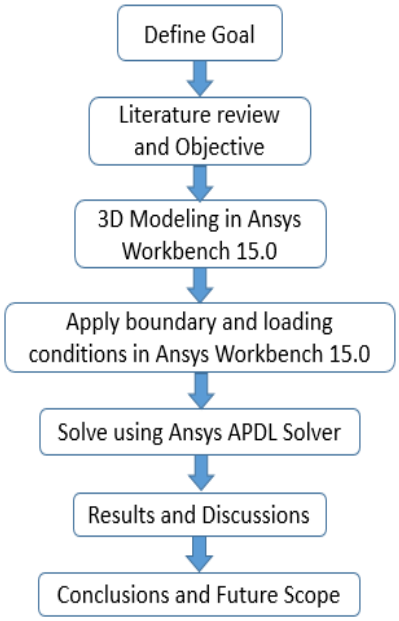

Fig. 1 Simulation Flow Chart

In analysis process physical, thermal, material and chemical properties is applied on 3D object under study according Indian Standard. The study of object is done for various boundary condition and constraints. In analysis process forces is applied on object, the obtained result like stress, strain, displacement, deformation etc. is studied. The solution done using Ansys APDL Solver.

3- Result and Discussions

After applied 100 Kg (981 N) compressive force on all the three types of brick for same boundary conditions, generated results in form of deformation and von mises of stress by using Ansys workbench.

I. Type A brick Results-

No material is removed for this kind of brick. Created as per Indian Standard, results are following as:

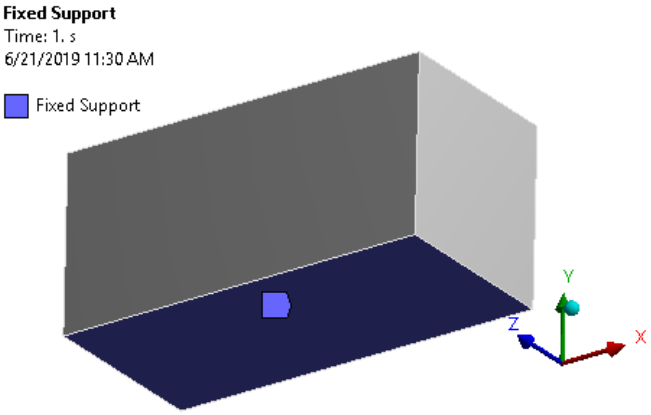

Fig. 2 Fix Support on Type A brick

In Fig. 2 shows fix support applied area, that are highlighted as blue color area. Fix support means zero degree of freedom, means it cannot move or rotate.

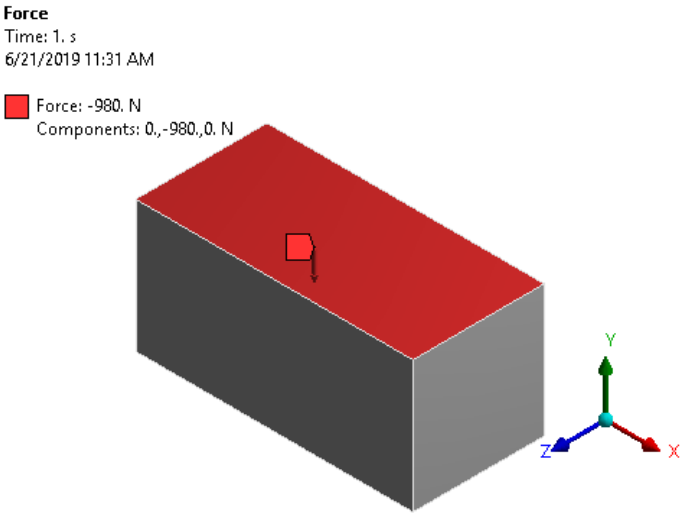

Fig. 3 Compressive force applied on Type A brick

In Fig. 3 shows compressive load 100 Kg (981 N) applied area that are highlighted as red color area. Compression load, means type of load that create compression called as compression force.

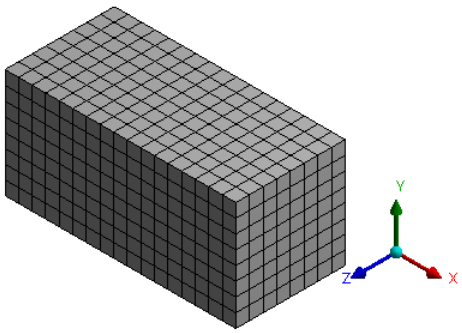

Fig. 4 FEA model of Type A brick

In Fig. 4 shows Finite Element Analysis (FEA) model of Type A brick. In this meshing process created hexahedral element of 8 nodes, it means every element have 8 nodes.

Nodes	5427
Elements	1088

Fig. 5 No of elements and nodes

This type element looking like a cube shape. In this FEA model 1088 elements and 5427 nodes created after meshing as shows in Fig. 5.

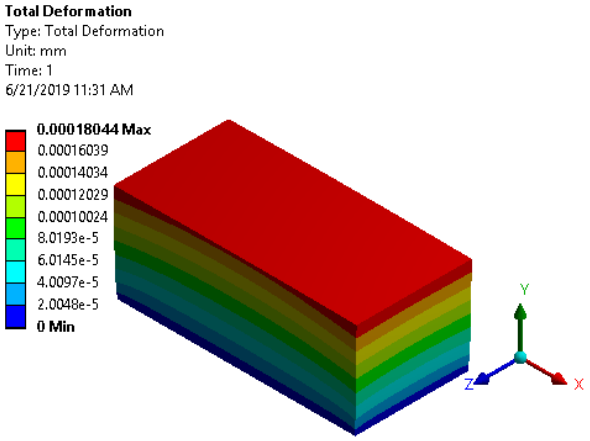

Fig. 6 Deformation of Type A brick

In Fig. 6 shows total deformation after applying compressive load of 100 Kg (981 N). Red color area means area under maximum deformation (0.00018044 mm) and blue means area under minimum deformation (0 mm).

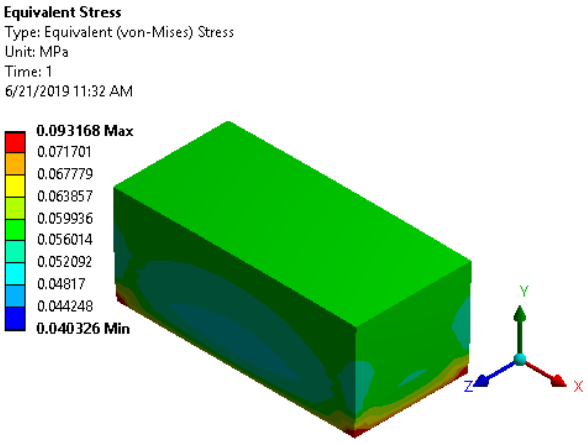

Fig. 7 Von mises stress of Type A brick

In Fig. 7 shows von mises stress after applying compressive load of 100 Kg (981 N). Red color area means area under maximum von mises stress (0.093168 MPa) and blue means area under minimum von mises stress (0.040326 MPa).

II. Type B brick Results-

Two Cubical shape material is removed for this kind of brick. Created as per Indian Standard, results are following as:

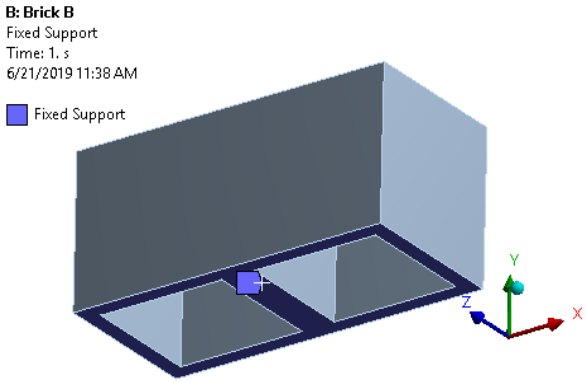

Fig. 8 Fix Support on Type B brick

In Fig. 8 shows fix support applied area, that are highlighted as blue color area. Fix support means zero degree of freedom, means it cannot move or rotate.

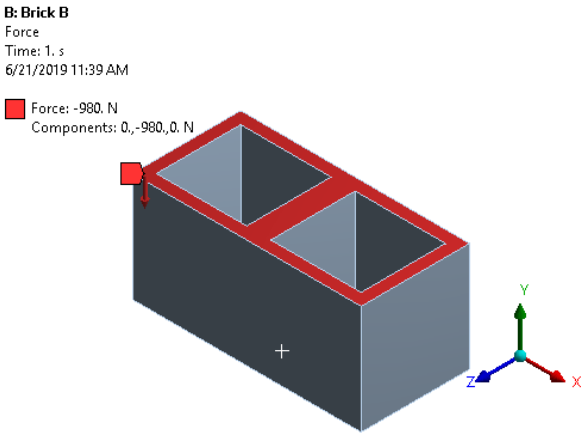

Fig. 9 Compressive force applied on Type B brick

In Fig. 9 shows compressive load 100 Kg (981 N) applied area that are highlighted as red color area. Compression load, means type of load that create compression called as compression force.

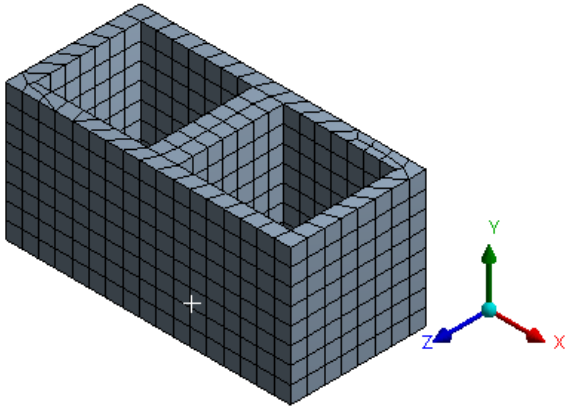

Fig. 10 FEA model of Type B brick

In Fig. 10 shows Finite Element Analysis (FEA) model of Type A brick. In this meshing process created hexahedral element of 8 nodes, it means every element have 8 nodes.

Nodes	3750
Elements	552

Fig. 11 No of elements and nodes

This type element looking like a cube shape. In this FEA model 552 elements and 3750 nodes created after meshing as shows in Fig. 11.

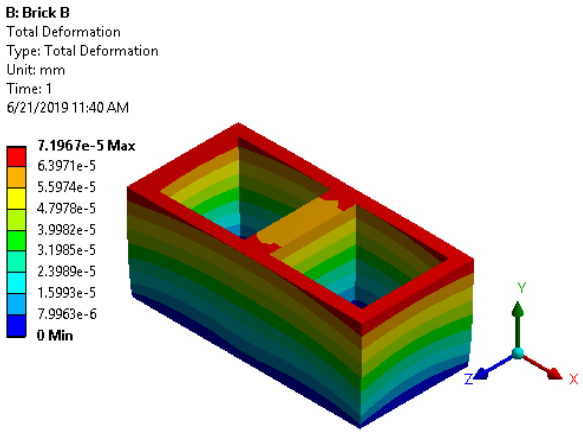

Fig. 12 Deformation of Type B brick

In Fig. 12 shows total deformation after applying compressive load of 100 Kg (981 N). Red color area means area under maximum deformation (.000071967 mm) and blue means area under minimum deformation (0 mm).

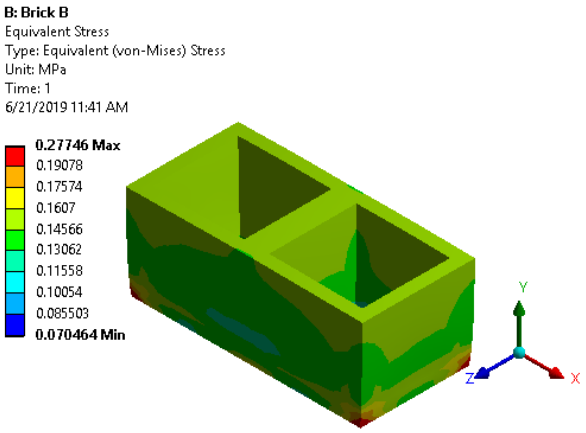

Fig. 13 Von mises stress of Type B brick

In Fig. 13 shows von mises stress after applying compressive load of 100 Kg (981 N). Red color area means area under maximum von mises stress (0.27746 MPa) and blue means area under minimum von mises stress (0.07464 MPa).

III. Type C brick Results-

Two cylindrical shape material is removed for this kind of brick. Created as per Indian Standard, results are following as:

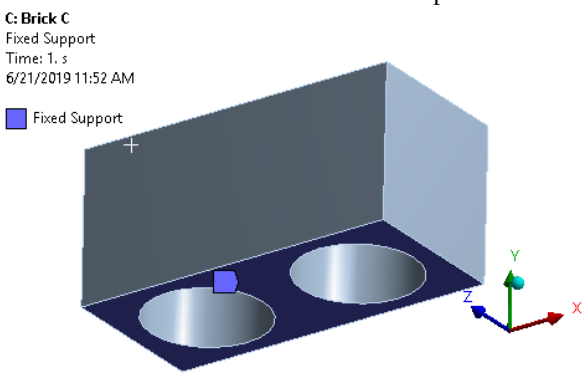

Fig. 14 Fix Support on Type C brick

In Fig. 14 shows fix support applied area, that are highlighted as blue color area. Fix support means zero degree of freedom, means it cannot move or rotate.

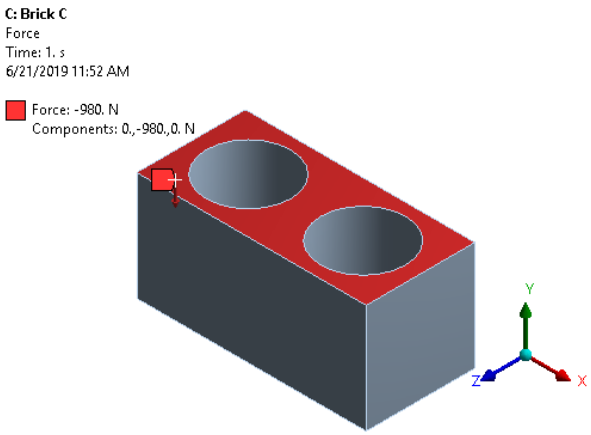

Fig. 15 Compressive force applied on Type C brick

In Fig. 15 shows compressive load 100 Kg (981 N) applied area that are highlighted as red color area. Compression load, means type of load that create compression called as compression force.

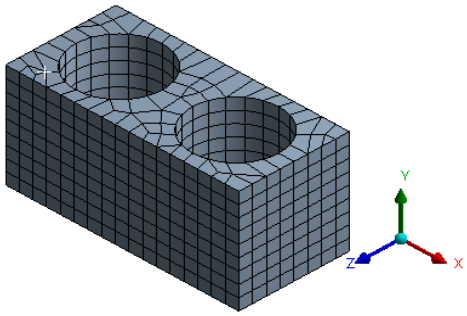

Fig. 16 FEA model of Type C brick

In Fig. 16 shows Finite Element Analysis (FEA) model of Type A brick. In this meshing process created hexahedral element of 8 nodes, it means every element have 8 nodes.

Nodes	3750
Elements	552

Fig. 17 No of elements and nodes

This type element looking like a cube shape. In this FEA model 552 elements and 3750 nodes created after meshing as shows in Fig. 17.

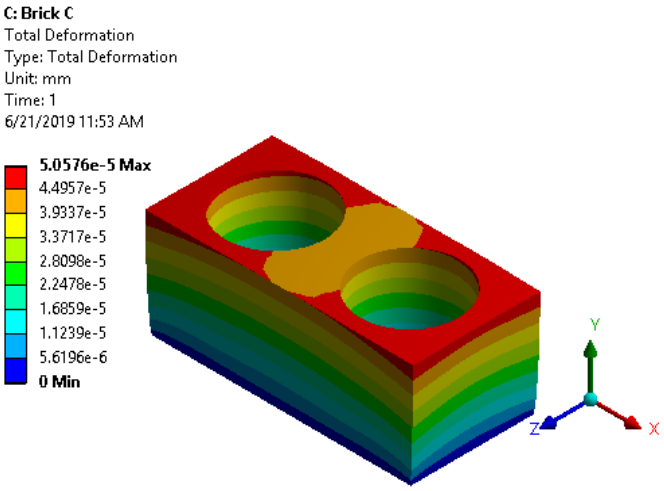

Fig. 18 Deformation of Type C brick

In Fig. 18 shows total deformation after applying compressive load of 100 Kg (981 N). Red color area means area under maximum deformation (0.000050576 mm) and blue means area under minimum deformation (0 mm).

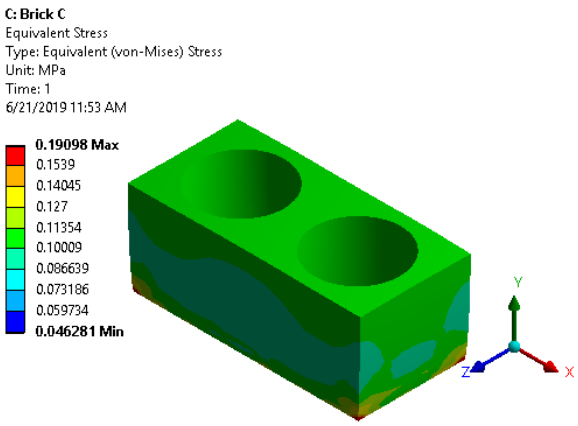

Fig. 19 Von mises stress of Type C brick

In Fig. 19 shows von mises stress after applying compressive load of 100 Kg (981 N). Red color area means area under maximum von mises stress (0.19058 MPa) and blue means area under minimum von mises stress (0.046281 MPa).

Conclusion

Standard size of Fly Ash brick is studied for different cross-sectional area on Ansys workbench 15.0 version. In first case standard size of brick 190X90X90 mm is studied, for second case two cubical cross-section volume is cut from the brick and for third one two cylindrical cross-sectional volume is cut from the brick and all the three shape are subjected to same loading condition and it is found that third shape with two cylindrical volumetric cut have better performance in comparison to other two shape.

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