INVESTIGATION AND REDESIGN OF PAN CONVEYOR BUCKET USED IN CEMENT INDUSTRY

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ISLAMABAD, PAKISTAN2018

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A thesis presented to the International Islamic University, Islamabad in partial fulfillment for the degree requirement of

Bachelor of Science

In

Mechanical Engineering

2018

Islamabad, Pakistan

AUTHOR'S DECLARATION

“We hereby declare that this project is entirely our own work other than the counsel of our supervisor and that it has not been submitted for any academic award, or part thereof, at this or any other educational establishment.”

Abstract

The pan bucket conveyor is used in different industries e.g. cement, sugar industries etc. The main objective of this project is to first investigate the root causes of failure (bending in plates of bucket) and then redesign of bucket through modeling and testing on software. Redesign bucket would have least failures which will reduce the maintenance cost and will increases the life of bucket.

Keywords: Investigation, design, redesign, fabrication

Acknowledgements

We are thankful to Allah Almighty who created the universe and bestowed the mankind with knowledge and wisdom. Without blessings of Allah Almighty we were not able to achieve the task. First and foremost our gratitude should go to our worthy parents who supported us where we need them and for their moral assistance. They make us able to live comfortable life and sacrifice all their pleasure for us.

We are very grateful to our honorable project supervisor **Engr. Ishfaq khan** for his inspiration and thought provoking measures. He provided his extraordinary favor during the completion of research work. We must express our views to the respective project supervisor for his time to time help in these words that without his affection and clemency our project work should be like a tree without fruit, like a garden without flowers, like a banquet without rose and like a lamp without light. With his kind help our project would be in the words of William Boyes, “Catching a black cat in a dark room by a blind person.”

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CHAPTER 1 INTRODUCTION

1.1 Project Title

Investigation and Redesign of Pan Bucket used in Cement Industry

1.2 Background

Cement is a standout amongst the most essential Mechanical area and wellspring of exchange of Pakistan there are numerous private restricted organizations all through Pakistan having enormous volume of exchanging giving huge business fit as a fiddle of little and huge merchant of cement item locally and universally.

Cement Industry is assuming crucial part in financial advancement to advance the fare and lessening the joblessness of nation by giving chances to gifted and untalented labor, in excess of 1.5million Pakistani working with industry and more finished is a piece of its exchange. Pakistan is positioned fifth on the planet's cement send out. Industry has a creation limit of 2o million tons out of which Pakistan sent out approx. 11million tons of cement which earned prominent remote trade for the nation by in excess of 20 constrained organizations working in cement division having processing plants in particular zones where crude material is effortlessly accessible so the vast majority of the cement ventures are situated at those areas where earth, iron and minerals, calcium carbonate or lime are the essential materials for cement. Subsequent to evacuating the overweight a multi organize squashing process included the advanced innovation and lively labor to decrease the stone and load in to truck which is itself relentless occupation require gifted labor and current hardware for pounding process present day cement industrial facilities are found shut to wellspring of lime stone as around 1.50 tons of lime stone is expected to deliver one ton of cement.

1.3 Processes in Cement industry

Cement process consist of three stages

Raw Material Preparation

Raw materials that are in use i.e. Calcium Carbonate, Silicon, Alumina and Iron ore are produce from limestone rock, chalk, Shale or Clay and Ferro containing material. Milling materials are used to crush these raw materials for the further processes at the query site.

Pyro Processing

Crushing produces a fine powder known as crude dinner, which is warmed and afterward sent to oven. The crude supper is warmed to around 1450 ºC, where a concoction response happens to shape cement clinker.

Cement Grinding and Distributions

A little measure of gypsum is added to the clinker to manage cement setting time. The blend is then finely ground to acquire unadulterated cement. The cement is put away in storehouses or capacity before being disseminated in mass or in packs to the destinations where it will be utilized

Figure 0-1 View of Cement industry showing Pan Conveyor and Clinker Yard [1]

1.4 Problem Definition

This project contains the study of the pan bucket mounted on conveyor used in various industries. Pan conveyors are used to transport different processing material. Pan Buckets mounted on the conveyors carry material and transport it to the area where material is further processed. In cement industries after the hot clinker coming from kiln is cooled at cooler, it is transported from cooler to clinker yard in buckets mounted on conveyors. This clinker is at a temperature of 180-220ºC which results in the deformation of bucket. This deformed bucket has to be replaced to make the working of conveyor smooth and easy. In this way industries buy new buckets and as the result in more expanse. These buckets are generally imported from Germany, China and Japan making the process more expensive. The main objective of this study is to redesign the bucket that would have greater life, efficiency and could bear more loads hence making the process of transportation smoother.

The project involves the design and manufacturing of a Pan Bucket for Cement industries using Solid works. It is a design based project. Prior to designing project contain research and study for the reasons behind the failure. After studying failures a proper study is done for the purpose of redesign. The simulations are further done on redesigned model of the Pan Bucket in Solid Works software. Different designed model would be tested and the model showing the best results will be used. Main Focus of the project is to design a Pan Bucket which can be adjustable and can work properly on conveyors currently working in an industry.

1.5 Project Scope

In Cement Sector after the processing of raw material in kiln it becomes clinker. This clinker is cooled to 180-200 ºC. It is transported to the clinker yard by pan conveyor Bucket. These buckets are arranged such that it makes long chains of buckets. These buckets are deformed after three to four months because of that they had to be replaced. Deforms buckets cannot work. The redesigned bucket would resist more to the deformation hence providing greater life and less manufacturing cost as well as less maintenance cost to the industry.

- Pan Buckets are designed to transport large quantities of abrasive or hot bulk materials over long distances. They are used in:
- Coking plants
- Blast furnace plants
- Metallurgical plants and steel works facilities
- Foundries
- Cement, gypsum and other similar industries

1.6 Types of Pan Bucket Conveyors

Five different types of Pan Conveyors are used in the industry that are (Pan / bucket conveyors, n.d.)[28].

TP - Pan conveyors:

Reasonable for passing on any mass material, even at high temperatures and ideally granulated, either on a level plane or with low slant (up to 28°). These pan conveyors comprise of a metal deck framed by a progression of base pans with transversal reinforcement twists, covering closes for conveying fine-grained material and side dividers, to shape a versatile control channel for the material being transported.

Functional specifications:

- Recommended speed: < 0.30 m/s.
- One or more bends can be incorporated on the vertical plane (suggested sweep > 15 m).
- Material is pulled on the upper run.
- Multiple material take-up focuses can be incorporated along the conveyor however just a solitary release end, under the drive station.

Figure 0-2 TP - Pan Conveyors [2]

TPT – Pan Conveyors with baffles:

Appropriate for passing on any mass material, even at high temperatures and ideally granulated, at a slant surpassing 28°. These pan conveyors comprise of a metal deck framed by a progression of base pans with transversal reinforcement folds, covering closes for conveying fine-grained material and side dividers, in order to shape a portable control channel for the material being transported. The consistent pitch pans are furnished with astounds that gap the channel into compartments to keep the material from streaming downwards. Two Connection chains with pins and settled bushings, which are dashed under the pans, associate the different pans in order to frame a nonstop jointed deck on account of the chain pins.

Every fourth or fifth pan mounts a couple of rollers with managing edge and moving component course: the previous move on proper tracks and bolster the metal deck on both the upper driving run and on the lower return run. The vertical help structure involves trestles (two little sections with crossbeams), while the level help just comprises of the tracks associating the trestles dispersed out at standard interims. The drive station in the release zone incorporates a drive unit that grants development to the deck, while the arrival station on the contrary end incorporates the tie take-up station.

Functional specifications:

- Recommended speed: < 0.30 m/s.
- One or more bends can be incorporated on the vertical plane (suggested sweep >15 m).
- Material is pulled on the upper run.
- Multiple material take-up focuses can be incorporated along the conveyor yet just a solitary release end, under the drive station.

Figure 0-3 TPT – Pan Conveyors with baffles [3]

TC - Box conveyors:

It is mostly utilized for passing on any mass material at high temperatures and at an inclination surpassing 40°. These metal pan conveyors involve a progression of boxes equipped for passing on fine-grained material with no spills. Two Connection chains with pins and settled bushings, which are dashed under the crates, interface the different boxes to frame a persistent jointed arrangement on account of the chain pins.

Each second box mounts a couple of rollers with directing edge and moving component orientation: the previous move on proper tracks and bolster the arrangement of boxes both on the upper driving run and on the lower return run. The vertical help structure contains trestles (two little sections with crossbeams), while the even help basically comprises of the tracks associating the trestles separated out at normal interims. The drive station in the release zone incorporates a drive unit that confers development to the containers, while the arrival station on the contrary end incorporates the tie take-up station.

Functional specifications:

- Recommended speed: < 0.30 m/s.
- One or more bends can be incorporated on the vertical plane (suggested sweep > 10 m).
- Material is pulled on the upper run.
- Multiple material stacking focuses can be incorporated along the conveyor yet just a solitary release end, under the drive station

Figure 0-4 TC - Box conveyors [4]

TTP - Deep bucket conveyors:

Generally it is used for passing on any mass material, even at high temperatures, at an inclination outperforming 35°. It's an impeccable course of action when the vertical expansion of the conveyor must be confined. These metal pan conveyors incorporate a movement of jars fit for passing on fine-grained material without any spills.

Two remarkable Association chains with settled bushings and long sticks partner the two chains are hurried to the sides of the diverse buckets and association the toward the end fit as a fiddle a consistent jointed line, due to the chain pins. The completions of each long stick mount a few rollers with coordinating edge and moving part course: the past proceed onward appropriate tracks and support the game plan of jars both on the upper driving run and on the lower return run.

The vertical help structure incorporates trestles (two little segments with crossbeams), while the even help includes the track-holder bars partner the trestles which are isolated out at standard between times. The drive station in the discharge zone joins a drive unit that gifts improvement to the jars, while the entry station despite what might be expected end consolidates the tie take-up station.

Functional specifications:

- Recommended speed: < 0.30 m/s.
- One or more curves can be joined on the vertical plane (endorsed span > 10 m).
- Material is pulled on the upper run.
- Multiple material take-up centers can be consolidated along the conveyor yet only a lone discharge end, under the drive station.

Figure 0-5 TTP - Deep bucket conveyors [5]

TPL - Pivoting pan conveyors:

Typically utilized for on a level plane pulling any sort of mass material, even at high temperatures, at whatever point different middle of the road release focuses are required. The material can be transported on both the upper and additionally bring down keep running of the machine. The pan conveyors have a metal deck framed by a progression of long level bottomed pans that have upturned sides to contain the material. The end area of each pan covers the succeeding pan to frame a portable channel for containing the material being transported. Each pan mounts a couple of rollers as an afterthought with controlling edge and moving component course: these rollers precede onward proper tracks and bolster the metal deck on both the upper and lower runs. In addition, each pan mounts a transversal stick with connections at the finishes for association with the drive chains; the pins additionally help to balance out the pans evenly.

The aides have a unique shape close to the two finishes of the conveyor to keep the pans from tilting over and guarantee that their side dividers dependably confront upwards, with the goal that material can be passed on both the upper and lower runs. Two Connection chains with pins and settled bushings set on the sides of the conveyor drive the pan deck and offer an extra help for balancing out the pans. The vertical help structure involves trestles (two little sections with twofold crossbeams), while the even help basically contains the tracks interfacing the trestles which are divided out at general interims.

The drive station in the release zone incorporates a drive unit that bestows development to the deck, while the arrival station on the contrary end incorporates the tie take-up station. The two stations are outfitted with proper aides that keep the pans from tilting over, as beforehand said.

Functional specifications:

- Recommended speed: < 0.30 m/s.
- Material can be released from the upper to the lower run, while middle of the road release focuses might be introduced on the lower keep running along the whole conveyor; this takes into

account serving a battery of adjusted storehouses or making long stores. (Pan / bucket conveyors)

Figure 0-6 TPL - Pivoting pan conveyors [6]

1.7 Need Assessment

The need for the project is immense, as most of the Cement and Sugar Industries are using these buckets. These buckets play important role for carrying loads and transports it so that it can be further processed. In Cement industries as these buckets carry load at high temperature so some stresses are produced and expansion contraction phenomena occurs which results in failure of bucket. So, in this project the study is conducted on different stresses affecting the life and the performance of Bucket, methods to minimize these failures and the project includes the redesigning of Bucket, which will greatly increase the life of bucket that would reduce expenses to industry.

CHAPTER 2 LITERATURE REVIEW

2.1 Heat Transfer in Metal Sheet

Heat is a measure of warm vitality, can be exchanged starting with one point then onto the next. Heat streams from the purpose of higher temperature to one of lower temperature. The Heat content, Q, of a protest relies on its particular warmth, and its mass, m. The Heat Transfer is the estimation of the warm vitality exchanged when a protest having a characterized particular warmth and mass experiences a characterized temperature change.

In Pan bucket the heat transfers from the 12kg hot clinker which makes its temperature fluctuations. Because when the bucket is loaded its temperature increases due to hot clinker as the rule is that heat transfer from hot body to cold body. After the unloading process at clinker yard the heat from Bucket is transferred to the atmosphere making the bucket to decrease its temperature. These cyclic fluctuations results in thermal expansion and contraction.

The investigation of Heat transfer shows that heat transfers in three different ways that are conduction, convection, and radiation. These procedures can be depicted by means of numerical equations. (Lienhard & Lienhard, 2008)[23]

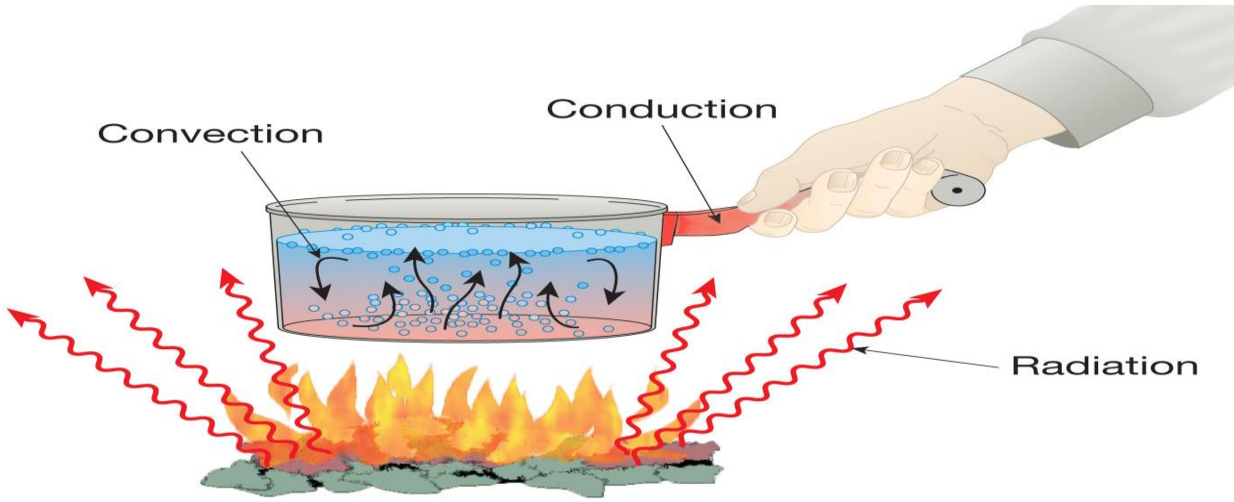

Figure 0-1 Process of Heat Transfer [7]

2.1.1 Conduction

In principle, heat goes from a hot to a chilly material/surface. Conduction is the heat exchange from a hot to an icy protest that is in guide contact to each other. The warm conductivity of the distinctive items chooses how much heat in which time is being exchanged. Cases incorporate CFL lights. In these Buckets this is happening as the clinker is hot and the heat is conducted by Bucket plates. The Bucket is made of metal and metal is said to be a good thermal conductors. When Clinker at temperature of 180-220ºC is loaded in a bucket, the temperature of the bucket gets high due to which the it began to expand and when it is unloaded the temperature falls, so this cyclic heating and cooling results thermal expansion and compression. So Heat conduction is one of the causes of failure.

2.1.2 Convection

Convective Heat Exchange is the exchange of heat between two territories without physical contact. The failure in the bucket shows that this process is not happening. As the failure is in the base plate and base plate is in physical contact of clinker. The convection may occur between the side plates of bucket and the hot clinker but the side plates are not facing any failure.

2.1.3 Radiation

Electromagnetic waves are the reason of heat exchange through radiation. They more often than not assume a part at high temperatures. The measure of heat that is produced by means of radiation relies upon the surface sort of the material. A general outcome is that the more surface there is, the higher the radiation is. A case application where recreation of radiation is utilized is the reenactment of laser shaft welding. This process might be involved in this process of pan bucket as the clinker is at very high temperature and consists of different particles that might emit radiation due to high temperature. (Advanced Heat and Mass Transfer, 2010)[21].

2.2 THERMAL EXPANSION AND CONTRACTION

Heating of metal plate at temperature results in expansion of metal plate and cooling cause's compression. The expansion and contraction with changes in temperature occur regardless of the body structure's cross-sectional sphere. Metal grow with expanding temperature on the grounds because of mean spacing among the nuclei somewhat increases because of the more kinetic energy of the molecules - they vibrate with more prominent adequacy and on the normal get themselves somewhat separated a part. The kinetic energy includes the atom all in all. Because of these conditions stresses are set up inside the metal plate. Stresses produced results in distorting or buckling of the metal. These stresses must be diminished by proper precautions. If surrounding poise divisions of the alloy are too heavy to permit this modification in shape, the stresses remain within the metal itself. (Negative thermal expansion phenomenon in solids, 2011)[24]. These stresses may result in cracking when plate is cooled or may stay behind within the metal plate unless additional effort is exerted, as when the plate is put into use. In design process it is important to consider thermal expansion and compression. There must be evaluation of interconnection between heat transfer and structural mechanics concentrating on the material of plate as well on its displacement pasture. (The Effects of Cold on Iron and Steel, 1871)[29].

Thermal expansion by and large declines with expanding bond energy, which additionally affects the melting purpose of solids, along these lines, high melting point materials will probably have bring down thermal expansion. As a rule, fluids extend marginally more than solids. The thermal expansion of glasses is higher contrasted with that of precious stones. (Configurons: Thermodynamic parameters and symmetry changes at glass transition, 2008)[26].

Table 0-1 Thermal Expansion and Contraction of Mild steel at different temperatures

Material	**Length at –100˚C (cm)**	**Length at 0˚C (cm)**	**Length at 100˚C (cm)**
Mild Steel	99.89	100	100.11

Extreme issues create in structures where warm can't be dispersed. Warm compression on the metal sheet surface without a comparing change in its inside temperature will cause a warm differential and possibly prompt breaking. Temperature changes that bring about shortening will break steel individuals that are held set up or by inward support. For instance, sheet metal is permitted to drop in temperature. As the temperature drops, the steel has a tendency to abbreviate, this makes the metal sheet be pushed, and in the end split.

This is the main process happening in the bucket and failing the pan bucket. It can be minimized by designing the bucket so that the heat dissipation becomes easier and the bucket should get minimum time to heat and cool in this way the thermal expansion and compression will decrease.

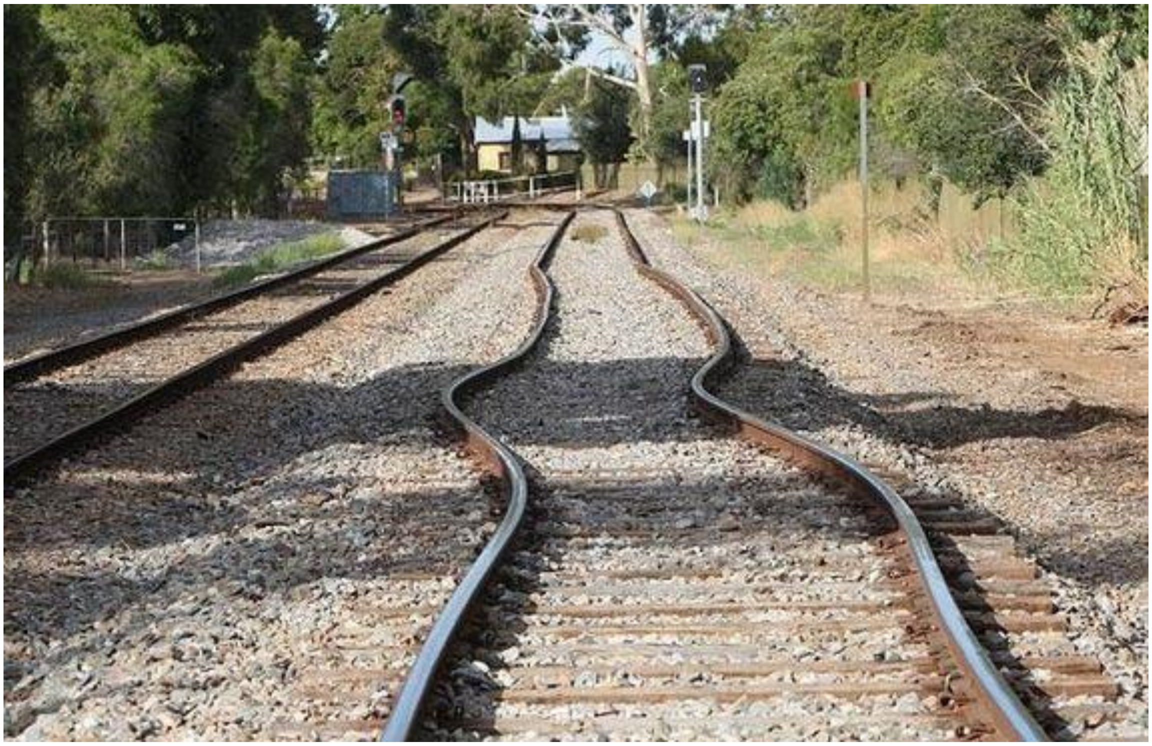

Figure 0-2 Thermal Expansion in Railway Track [8]

2.3 Buckling

A plate is a 3-dimensional structure characterized as having a width of Equivalent size to its length, with a thickness is little in contrast with its other two measurements. Like sections, thin plates understanding out-of-plane clasping misshapen when subjected to basic burdens; be that as it may, differentiated to segment buckling, plates under clasping burdens can keep on carrying loads, called nearby buckling. This occurrence is inconceivably valuable in various frameworks, as it enables frameworks to be designed to give more noteworthy loading limits.

The buckling relates with loading stresses as the stacked stress increment, the powerful width keeps on contracting; if the stresses on the closures ever achieve the yield stress, the plate will come up short. This is the thing that permits the buckled structure to keep supporting loadings.

At the point when the pivotal load over the basic load is plotted against the dislodging, the essential way is appeared. It shows the plate's comparability to a segment under clasping; in any case, past the clasping load, the major way bifurcates into an optional way that bends upward, giving the capacity to be subjected to higher loads past the basic load. It is fascinating to analyze the dependability of a column and a plate. (Buckling Strength of Metal Structures, 1952)[22].

On account of a perfect column, as the axial load is expanded, when the axial load ends up equivalent to the Euler clasping load, the horizontal removal increments inconclusively at steady load. This is the optional way, which bifurcates from the key way at the clasping load. The optional way for column speaks to nonpartisan harmony. For functional columns, which have introductory defects, there is a smooth progress from the stable to impartial balance ways. The major way for a splendidly level plate is like that of a perfect column. At the basic clasping load, this way bifurcates into an optional way. The optional way mirrors the capacity of the plate to convey loads higher than the elastic basic load. Actual failure load of the plates are reached when the yielding spreads from the supported edges triggering collapse and thereafter the unloading occurs. (Theory of Flat Plates, 1970)[27].

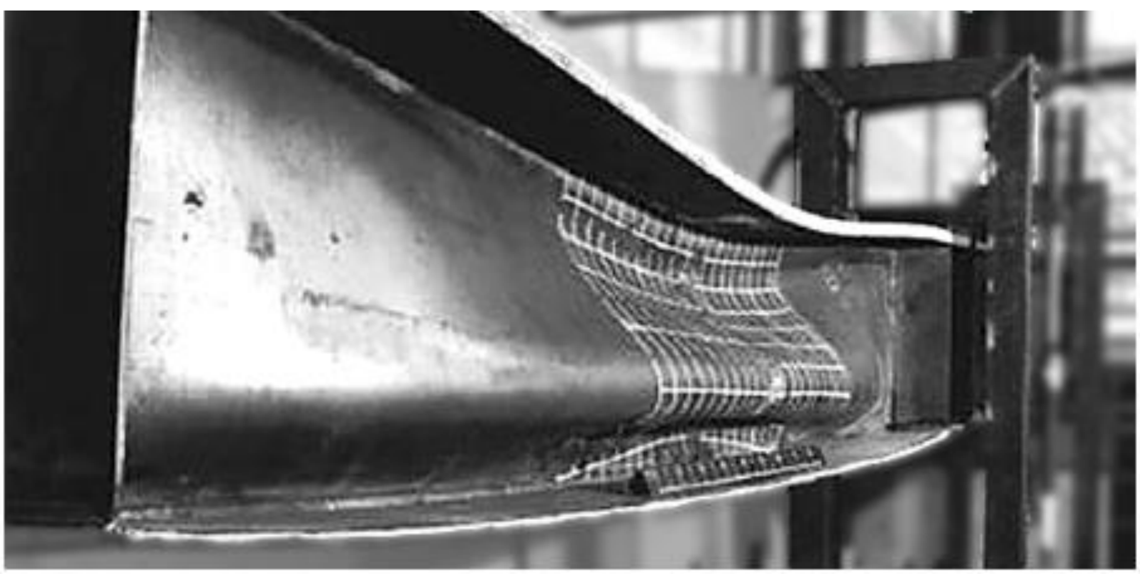

Figure 0-3 Buckling in a vertical plate [9]

2.4 Stress concentrations

While the manufacturing of the mild steel plates, little stress fixations frequently happens. During the time when plates are facing the outside stress, these stress concentration are amplified which might results in failure while these plates gets cool from their process temperature large amount of stresses are produced in the plates. Similarly as we know some of stresses are there in the plates when they are manufactured when hot clinker impact on the pan bucket base plate, Those built in stresses are magnified which increase the tensile stresses of the plate hence making it deform. These stresses can be relieved by some methods hammering etc. If these stresses exceeds very much from the yield strength of the plate there would be the crack initiation in the plate thus making the bucket totally damaged. But according to the sample of the deformed plates in the industry there is no crack in the plate thus making this perception wrong. But the stresses are there in plates which may magnify if the extra loads are applied. The other stresses like the thermal and von misses stresses also play role in the deformation and failure of the plates

2.5 Von –Misses Stress

The von Misses pressure is frequently utilized as a part of deciding if an isotropic and bendable metal will yield when subjected to a multiplex condition. This is refined by figuring the von Misses pressure and contrasting it with the material's yield pressure, which constitutes the von, Misses Yield Standard. According to the principle of mechanics, if the maximum bending stress produced by the applied load is less than the ultimate tensile strength of the material then the material can withstand the applied load without failure and vice versa. Von misses stresses decrease when the plate thickness is increased and it increases if the von misses stresses are decreased. Increasing the thickness will results in increase in the ultimate tensile strength which can resist more von misses stresses. (Von Mises Criterion (Maximum Distortion Energy Criterion), 2018)[20].

2.5.1 Uniaxial (1D) stress

Overall Equation of Von Misses stresses is

$$\sigma_y = \sqrt{\frac{(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2}{2}}$$

In the case of uniaxial stress or simple tension as in our this case only load is applied on y-axis so,

$$\sigma_1 \neq 0 \ ,$$

$$\sigma_3 = \sigma_2 = 0$$

$$\sigma_1 = \sigma_y$$

The von Misses criterion simply reduces which means the material starts to yield when reaches the yield strength of the material, in agreement with the definition of tensile (or compressive) yield strength. In the pan bucket as clinker load is applied only in one direction so the von Misses stresses will be only in one direction. This means in case the ultimate strength of the base plate of bucket is equal to the stresses applied in the y-axis the base plate will start to yield.

2.6 Strengthening Methods of metal Sheet

Metal sheets in spite of the fact that can be made more effective and tough through a few ways and here we have portrayed a couple of ways of it. (Ways of Strengthning of Metal Sheets)[19].

Bending

A regular metal sheet is doubtlessly not exceptionally intense, although it can be made more effective by bending. By Bending process the metal sheet gain more strength , in spite of the fact that there's something that ought to be recalled. It might outcomes in cracks on the external surface and ‘bending radiuses’ should be considered. The least radius that may bend the sheet without breaking it on the external surface is called bending radius. Metal sheet ought to be bent at least possible bent radii.

Bend Allowance Formulae for Metal Sheet

The extent of the curve of the neutral line between the tangent points of a bend in any kind of material is bend allowance (BA). This bend remittance equation is utilized to decide the level example length when a bend is dimensioned from (Benson, Steve D, 1997)[18].

- Focal point of the radius
- Tangent point of the radius
- The outside tangent point of the sweep on an intense bend angle

The BA can be evaluated utilizing the accompanying equation, which fuses the experimental K-factor:

$$\boldsymbol{BA = A\left(\frac{\pi}{180}\right)(R + (K \times T))}$$

1. Lf = flat length of the sheet.
2. BA = bend allowance.
3. BD = bend deduction.
4. R = inside bend radius.
5. K = K-factor, which is t / T.
6. T = material thickness.

7. t = distance from inside face to the neutral line.

8. A = bend angle in degrees (the angle through which the material is bent)

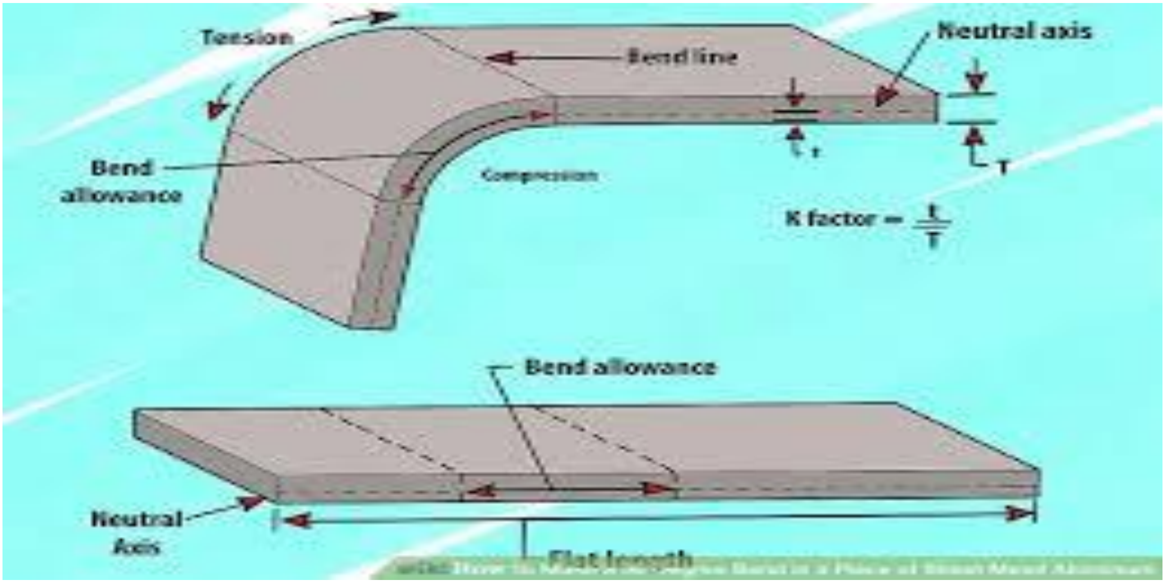

Figure 0-4 Bend Allowance in Bended plate [10]

Holes and Slots

Punching holes and slots is another method of strengthening the metal sheet. The Metal sheet areas where holes and slots are punched become greatly tensile and stretched providing the metal sheet greater rigidity in its structure. The strength of the metal sheet is greatly increases providing more resistant toward tensile stresses. Holes and slots cannot be done in the Bucket plate as they would not be able to handle clinker.

Wire Edging

Wire edging is a procedure in which the edge of the sheet metal is moved over on a metal wire, giving the sheet solid edges. Wire edging has been a generally utilized sheet metal-reinforcing technique for quite a while.

Changing the profile of the sheet

The profile of a sheet metal is something essential that can give quality to it if alternated. Disturbing the profile should be possible by giving a lump or a bend to the sheet metal basically by a hand instrument like a mallet and a sandbag or a bite the die press.

Using of composite material

The use of composite material and alloys in pan bucket according to the operating condition will ensures the greater life of bucket. But it may increase the material cost for manufacturing of bucket and it may not be available at ease so that's why mild steel is used. Mild steel is cheap as compared to the alloys and is easily available.

2.7 Material Selection

Why Use Steel instead of Other Metals

As shown in table Steel and bronze has low thermal conductivity from any other metals. As material required should conduct the least heat coming from the clinker so we remain with choice of these two metals. Steel is cheaper as compared to the Bronze so steel is the best choice used in manufacturing of conveyor bucket.

In general, good conductors of electricity (metals like copper, aluminum, gold, and silver) are also good heat conductors, whereas insulators of electricity (wood, plastic, and rubber) are poor heat conductors. The figure below shows molecules in two bodies at different temperatures. The (average) kinetic energy of a molecule in the hot body is higher than in the colder body. If two molecules collide, an energy transfer from the hot to the cold molecule occurs. The cumulative effect from all collisions results in a net flux of heat from the hot body to the colder body. We call this transfer of heat between two objects in contact thermal conduction**.**

Table 0-2 Thermal Conductivity of different Metals

Rank	Metal	Thermal Conductivity[BTU/(hr.ft.ºF)]
1	Copper	223
2	Aluminum	118
3	Brass	64
4	Steel	17
5	Bronze	15

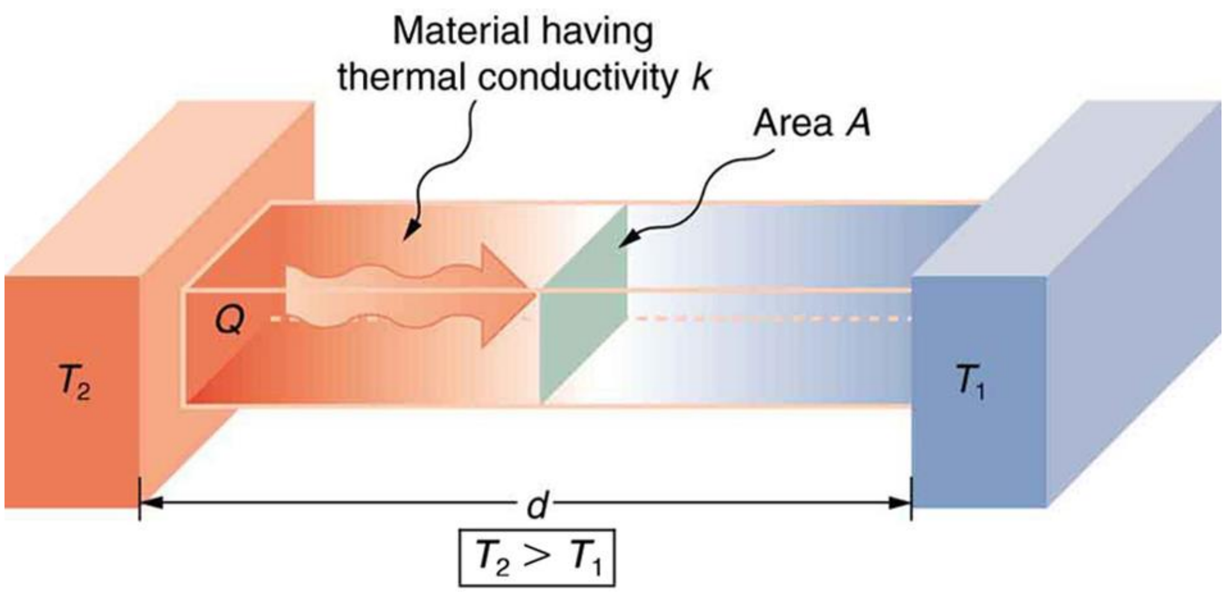

Figure 0-5 Heat Transfer process in metals [11]

2.8 Why Choose Mild Steel (MS) Over Stainless Steel

Factors making mild steel better over stainless steel are (Mild Steel vs Stainless Steel, n.d.)[25]:

Costing:

Cost is an imperative factor that will be considered in the Manufacturing Industries. Mild steel is an economic type of iron-carbon combination, and thus is modest and reasonable to be utilized as a part of the spine Manufacturing Industries.

Stainless steel is just more costly to make and machine. When it is welded it changes its shape and needs exceptionally gifted and experienced welders. Likewise, stainless steel contains extra aggravates that lessens hydro-erosion and builds the hardness of the steel. This makes is more costly, less pliable and will probably experience the ill effects of pressure weariness and stress cracks, which requires a ton of settling, consequently expanding the cost factor and making it less reasonable to be utilized for the making of ribs.

Stability:

Mild steel is the most widely recognized high volume steel underway. It is regularly utilized when a lot of steel is required, for instance as auxiliary steel .Mild steel is the most well-known type of steel as its cost is moderately low while it gives material properties that are adequate for some applications particularly in the rib making ventures. Then again Stainless Steel is a hard, delightful metal which is perfect for furniture and workmanship stylistic theme however finds lesser applications in Manufacturing Industries and particularly that of spines because of the cost factor, weakness, non – flexibility, and so forth.

Malleability:

Mild steel is any day more mold-able than stainless steel, thus clearing its way in to the assembling ventures and its inordinate use in spine making. It is liable to erosion yet is flexible and does not experience the ill effects of the weakness issues of stainless steel along these lines making stainless steel less successful to be utilized as a part of spine making.

Corrosive properties:

With regards to protection from erosion, mellow steel is significantly more powerless when contrasted with steel. Essentially, steel contains an adequate measure of chromium that causes it shape a sort of inactive film made out of chromium oxide that counteracts advance consumption. Do remember that there are current medicines that can be connected to gentle steel which can enable postponement or totally to avert erosion in it too.

Hardness and Strength:

Gentle steel is less hard than that of stainless steel as stainless steel diminishes hydro-erosion and expands the hardness of the steel. However, this makes it less pliable. Gentle steel has a sensible quality and hardness it is less demanding to weld than stainless, and it is less expensive. Despite the fact that gentle steel has a generally bring down elasticity, it is moldable and bendable, exceedingly reasonable for the assembling of spines. However gentle steel can be solidified by expanding the carbon substance and surface hardness can be expanded through carbonizing.

Weight:

Mild steel weighs not as much as that of stainless steel. Stainless steel measures more because of its solidifying properties and has a lesser inhabitant to be utilized for spine making as it makes it hard to be dealt with amid the assembling procedure.

REFERENCES

(1) Benson, S. D. (1997). Benson, Steve D. A Guide to Precision Sheet Metal Bending. Society of Manufacturing Engineers.

(2) Company, J. P. (n.d.). Ways of Strengthning of Metal Sheets. Retrieved from jash metrology: Edge, E. (2018). Von Mises Criterion (Maximum Distortion Energy Criterion.

(3) Faghri, A. Z. (2010). Advanced Heat and Mass Transfer. Columbia: Global Digital Press.

(4) H., B. (1952). Buckling Strength of Metal Structures. McGraw Hill.

(5) Lienhard, J. H., & Lienhard, J. H. (2008). A Heat Transfer Textbook 3rd ed. Massachusetts: A Heat Transfer Textbook.

(6) Liu, Z.-K. (2011). Negative thermal expansion phenomenon in solids. Scripta Materialia.

(7) Ojovan, M. I. (2008). Configurons: Thermodynamic parameters and symmetry changes at glass transition.

(8) P.S, B. (1970). Theory of Flat Plates. London: Chatto and Windus.

(9) http://www.jashmetrology.com/5-easy-ways-strengthen-sheet-metal/

(10) Mild Steel vs Stainless Steel. (n.d.). Retrieved from E . S Haji & Co: http://eshaji.in/#home

(11)Pan / bucket conveyors. (n.d.). Retrieved from Gambarotta Gschwendt | Advanced Conveyor Technology: http://www.gambarotta.it/en/products/bucket-pan-conveyors/

(12)W, B. (1871). The Effects of Cold on Iron and Steel. The Railway Times.

(13)https://www.pakistantoday.com.pk/2016/05/30/fauji-cements-clinker-silo-plantcollapses/

(14)http://www.gambarotta.it/en/products/pan-bucket-conveyors/category/tp/

(15)http://www.gambarotta.it/en/products/pan-bucket-conveyors/category/tpt/

(16)http://www.gambarotta.it/en/products/pan-bucket-conveyors/category/tc/

(17)http://www.gambarotta.it/en/products/pan-bucket-conveyors/category/ttp/

(18)http://www.gambarotta.it/en/products/pan-bucket-conveyors/category/tpl/

(19)https://azchemistry.com/heat-transfer-through-conduction-example-in-daily-life

(20)https://www.quora.com/Why-are-there-crushed-stones-alongside-rail-tracks
(21)https://avaxhome.unblocker.xyz/software/DLUBAL-PLATE-BUCKLING-8-06-1103.html
(22)https://www.wikihow.com/Make-a-90-Degree-Bend-in-a-Piece-of-Sheet-Metal-Aluminum
(23)https://www.khanacademy.org/science/physics/thermodynamics/specific-heat-and-heat-transfer/a/what-is-thermal-conductivity
(24)Design and redesign of bucket done by HAMAD GOHAR on solid works software
(25)Design and redesign simulations done by HAMAD GOHAR on ansys 18.2 software
(26)http://www.ahycncs.net/hydraulic-press-brakes/nc-hydraulic-press-brakes/ahyawei-6m-large-plate-cutting-and-bending.html
(27)http://finishersantibes.com/hydraulic-sheet-cutting-machine/hydraulic-sheet-cutting-machine-97-inspiring-style-for-plate-benidng-machine-press/
(28)https://en.wikipedia.org/wiki/Magnetic_Drilling_Machine#/media/File:Magnetic_Drilling_Machine_from_BDS_Machinen_GmbH,_Germany.jpg
(29)http://www.selbyboltandnutltd.co.uk/