A. C. Mclaren

Introduction :

When our Company celebrated its 150th Anniversary just over a year ago, an exhibition was assembled at our main office.

Among the exhibits was a map of the world on which we pinpointed the location of every papermaking machine built by Bertrams Limited. It was significant to note that around the turn of the century we had supplied no less than 14 papermaking machines to India and I think we can justly claim that the papermaking industry in India was founded on machines supplied from Edinburgh.

Another exhibit in that exhibition was paper samples from one such machine still running in an Indian Mill to this day, making fine writing and printing papers.

It is on the assumption that there are many similar machines supplied in these early days and others, with perhaps not quite such a long history still performing in your mills that could well be looked at and improved by the introduction of modern techniques and standards. These machines can be given a new lease of life with much greater productivity.

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Upgrading of Existing Paper Making Machines to Modern Standards

This paper discusses the potential for higher productivity latent in many old papermaking machines whose origins can go back to the turn of the century and yet are still operating with little change throughout the world today.

A case study is presented of such a machine supplied in 1910 to a Scottish Fine Mill and after a recent modernisation crash programme is now producing 75% greater output on improved qualities without extending the length of the machine.

To explain how this potential can be developed I propose to present a case study of one such machine supplied to the Guard Bridge Paper Company Limited, Fife, Scotland, in 1910. This machine was recently rebuilt by us in a number of stages without the inconvenience of any appreciable down time.

Realising the threat of more and more imported papers coming into the United Kingdom, Guard Bridge undertook a crash modernisation programme on this particular machine. Because of its location in the mill we were told that they could not extend the machine house, and that we must contain the machine to its existing surroundings located on the existing foundations.

Increased Output and Higher Qualities

Increased output was their major consideration but emphasis at this mill was still on quality. The mill has a long reputation for high quality papers and it was part of their deliberate policy to produce on this machine even more expensive and higher quality papers to combat the overseas competition.

Planning and Engineering Stage :

Fully understanding the mills requirements and after a thorough survey of the site conditions, all original design drawing of this machine were looked out and a further examination of the existing parts undertaken to see how they now compared with our records.

A layout of the entire machine was then prepared showing how it was presently operating and directly below this how we projected to rebuild the sections where necessary. See Illustration Fig 1.

The machine had been operating with the following configuration---

Wire-8'-10" wide \times 60'-0" long with conventional open type head box, table rolls, top and bottom plain couchers.

Presses—Three plain presses, third being reversed.



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FIGURE 1

Dryer Part—Comprised 20'-54" diameter drying cylinders with a dry smoother and size press.

Calenders—three conventional stacks and a two spindle reel up stand. **Drive**—was of the old endless rope design with very vee sheaves. The main driving motor had **a** capacity of 140 H. P. but full advantage could not be taken of this because of the limitations of speed created by the rope drive system.

After the new layout was agreed, it was then a further necessity to discuss with the production personnel when convenient down time periods could be allocated for the installation of new sections and the order of priority they required the modifications complete to give them early benefits.

The maximum machine running speed had been restricted to around 200 ft/minute because of the limitations of the old endless rope drive. It was therefore a first priority that the new lineshaft and sectional gear box drive be installed as quickly as possible. It was found that much of this new equipment could be installed in the drive annex without disturbing the production runs on the machine.

When this first modification was carried out the machine speed was increased by over 100 ft/minute without any further major alteration to the machine layout at that stage. Remembering that we were not permitted to increase the overall length of the machine from breast roll to reel up, we then examined those sections of the machine which could be shortened using modern techniques of pressing and calendering to

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make space available for additional drying capacity. The existing press section accounted for approximately 30 feet of the machine length, and we were convinced that this could be reduced by improvements in design and new methods to less than 20 feet. A further 12 feet could be released by replacing the old three sets of calenders with one new modern swimming roll stack. A further 8 feet was also to be gained by replacing the old dry smoothing and size press arrangement by the latest design of inclined size press.

With this knowledge we then calculated that a further 8 drying cylinders could be added to the drying capacity of the papermaking machine. The new dryers were put in hand in our shop without delay as we required a number of these quickly so that we could systematically upgrade the 20 existing drying cylinders in batches of 2 or 4 at a time by removing the existing back and front heads and replacing with new heads but still retaining the existing shell. This had the desired effect of upgrading the existing drying cylinders to a higher steam pressure.

When the first of the new drying cylinders were completed we were able, over weekend periods, to install these in the machine thereby releasing existing cylinders in batches, and in this way all the existing cylinders were reconditioned without any appreciable lost production time on the machine.

At the same time as we reconditioned the cylinders we also fitted them with new force lubricated bearings to suit the higher running speeds anticipated. A rope feed system was also added at these stages.

We considered the necessity of fitting nylon rimmed dryer gears as we had supplied this new design of gear on other occasions to machines running at higher speeds, but in this instance we considered that the top speed, would not warrant this inclusion. Incidentally, nylon gears make it possible for open gear sections to run up to 1500 ft/minute without the need for lubrication and give much quieter running conditions.

When installing the reconditioned cylinders the opportunity was taken to remove all the old felt dryers and regroup and reclothe the sections with fabric drying screens.

Systematically the entire dryer part was also covered with an extraction hood to improve the working condition of the operators.

Major Installation Period

As agreed during the engineering and planning period it was accepted by the mill that we would be given the opportunity to install the modified wet end, press section, size press and calender during an extended two week summer shut down period. New head box would also be included at this time.

This called for careful progressing of all the new items in our shops t_0 ensure that they would be delivered to site in advance of the actual shut down period. It was also essential that all the labour was ready and organised to get ahead first with the dismantling of the material that was to be removed and any reconditioning of such rolls that we intended to use again. A two 12 hour round

the clock shift system was instituted to ensure that the installation would go on uninterrupted during every possible hour of the shut period. I shall now describe in brief detail

some of the new items of equipment

which were installed.

Head Box

In order to meet the demands for higher quality and a more even basis weight profile a new modern design of vacuum pressure type Flow Box was installed embodying the cross taper manifold, perforated baffle plate, variable speed evener rolls and vertical top slice adjustment See Fig. (2) attached.



As the new speed range of the machine was contemplated to vary between 200 and 800 ft/minute this box was provided with a vacuum pressure air cap. It was also carefully designed to give the appropriate velocities through the inlet header and flow compartments to accommodate the increased outputs. An internal rotating shower and inspection windows ensure the internal stainless steel surfaces are kept highly polished.

Fourdrinier Section

Improvements made to this section included an up to date supporting shake frame to carry the breast roll and a full set of foil units, new stainless steel wire vacuum boxes with high density polyethelyne tops were included.

Our Patent Baggallay Box Couch Transfer System replaced the old top and bottom couch arrangement See Figure (3)



FIGURE 3-BAGGALLAY BOX

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Wet Press Section

We now come to the key section of the machine from which we expected the most advantage from this modernisation programme. The machine we are discussing was typical of so many with old fashioned straight through and reversed presses. The paper web is in its most delicate state when passing through this stage of the process and yet the long leads and open draws subject it to many strains and changes in direction. It is little wonder that most of the breaks occurred in this area. The sheet was often supported again on the felt to avoid these breaks but this resulted in water finding its way back into the web again and miosture figures of 65% or more were common entering the dryer section Close co-operation with the felt manufacturers has brought about an entirely new concept of pressing in recent years and we now expect

56% to 57% moisture in the sheet as it meets the first drying cylinder. Taking advantage of the new design of wet felt, fabrics and heavier loading conditions we decided to install a straight through suction first press followed by an inverted second press.

Careful consideration was given to the design of the full width felt conditioner boxes. Each has a very high pressure oscillating needle jet cleaning shower; this shower however is only used intermittently, possibly five minutes in every four hours. A lower pressure lubricating vacuum sealing shower is made to run continuously. This design of press section is shown on Fig. (4).

With this new press design we achieved a 57% moisture figure leaving the second press and this in itself has the effect of increasing the overall paper production by approximately 33.13% without taking into consideration any additional efficiency from the dryer part. It should be noted that this improvement involved no increase in steam consumption and no increase in machine operating labour costs.

The major factor has been improvemented in design of wet press clothing and whereas we used batt-on-mesh a combitex felt in the second press location, similar results have been obtained from other installations using a fabric press conformation.

It should be pointed out here that all existing felt rolls in the wet press section were re-used although we provided automatic felt guiding and tensioning equipment.

Other advantages gained was savings in the total cost of felts as these new felts, require to be changed at much less frequent intervals than the conventional felts, also the moisture profile leaving the second press was very much improved and stabilised

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thus enabling the early cylinders to get right down to serious drying rather than trying to sort out uneven moisture profiles. The runability of the machine through the presses was also greatly improved.

The shorter draws reduced greatly the possibility of breaks and with the efficient rope feeding system it was possible to convey the sheet as quickly as possible from the couch to the first dryer.

Size Press

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A size press had been used on this machine for some years but was of a rather old fashioned design and because of its location the long leads caused runability problems. We took the opportunity to install one of our improved size presses using the latest technology in roller covering. The new location was calculated to cover increased output after taking into consideration a wide range of qualities to be produced. For a successful pass through the size press the sheet had to be dried to something under 5% moisture, and a pick up of approx. 25% resulted thus necessitating a careful check on the number of after dryers require.

Included in the supply was all the size preparation equipment which was located conveniently at the rear side of the machine.

Calender and Reel-up Station

The machine had been previously equipped with three stacks of calenders. These were very conventional in design with little or no flexibility with regard to loading conditions and frequently required re-grinding operations to adjust the camber to suit the various qualities.

With a swimming roll stack it is now possible to apply a first class finish to the sheet under varying conditions of quality being produced. It will also be appreciated that in addition to the saving of space there was considerable saving power requirement. After leaving the calender the sheet passes through an H.M.B. meter to a new fully automatic horizontal drum type reel, this reel being designed to suit the latest safety requirements as set down by the U. K. Department of Trade and Industry. Figure (5) That concludes the brief description of the main features of this machine. Many of the existing rolls are being re-used again after having been check balanced for the new speeds and fitted with antifriction bearings.

The dryer framework is as it was originally supplied over 60 years ago now, and is proving perfectly adequate for all running conditions up to 800 ft/minute.

Production on a 132 hour week before the reconstruction programme never exceeded 90 tons. This figure has now risen on average to 160 tons per week of the same number of working hours and they have recorded as high an output of 177 tons over this period.

The qualities made are—M. F. Printings and Bonds, White and Tinted Wood Free and Esparto Papers Body Coating and Gumming Base, Duplicator.

80% of the papers made are in the substance range 60 to 80 g. s. m. and 95% of the machines production is sold in reels.

The new driving motor has a top capacity of only 200 H. P.

The machine is now proudly classed as a showpiece machine by the mill personnel who look forward to many more years of excellent service from it.

I have with me various sample papers produced showing the wide range of qualities including writings, bonds, duplicating, tints, gumming base and coating base papers.

Many important people make use of Guard Bridge Papers—Mr. Harold Wilson for example has his memoirs published on paper produced on this machine.

Conclusion

Paper as we all know is a capital investment industry, and in view of the crash programme undertaken in your country to increase the productivity from the Indian Paper Industry I put it to you, gentlemen, that by carrying out exercises similar to the one described in this paper. many of your older machines could be upgraded to give at least 50% increase in production without anything like the investment figures required for a complete new installation.

The Guard Bridge Paper Company make no secret about the total amount of money they spent on this exercise—£300,000 or approximately one third of the cost of a completely new machine and all the other expenses involved in installing it in the new building on a new site, and bear in mind no appreciable loss of production occurred during the whole exercise. Any lost time that was incurred was quickly overtaken by the increased output which was achieved stage by stage throughout the entire re-building programme.

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REEL RELEASED FROM DRUM BY REVERSING MAIN CYLINDERS

FIGURE 5

It has been stated that with the rise in literacy and the growth in the level of economic developments in your country the demand for paper is growing rapidly. Your existing papermaking machinery industry is criticised at not having kept pace with the growth of your paper industry.

Our company has undertaken to .collaborate with Indo-Berolina Industries, an engineering group in Bombay, to give them the full benefits of our 150 years experience and knowledge in this specialised field of engineering. The opportunity exists for both you as the producers and ourselves as suppliers; let us not miss the chance of grasping it.

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