Volume 27. Toronto, July 16, 1914

Contents of this issue on page 3

The Canadian Engineer

A weekly paper for engineers and engineering-contractors

WATER SUPPLY FOR CITIES AND TOWNS

AN OUTLINE OF THE PROBLEMS CONNECTED WITH WATERWORKS CONSTRUCTION AND VALUABLE HINTS AS TO THEIR SOLUTION.

By BERNARD E. T. ELLIS, C.E.,
Oborn and Ellis, Consulting Civil Engineers, Toronto and Hamilton.

AMONG the problems which attend the establishment of a water supply for a community the first, and often the most important, is its source, particularly in the case of towns and cities that are not so favored by nature as to be able to secure an ample and safe supply from adjacent lakes or rivers, but have to resort to wells, collecting grounds, etc.

The first step the engineer is called upon to decide is the selection of a suitable watershed and site for the proposed works, including the dam and reservoir. Since we depend solely upon rain for our supply of water, after these selections have been made it is necessary to find out exactly how much rain actually falls on the contemplated watershed drained by the stream which is to feed the impounding dam. To do this, rain gauges must be fixed on the watershed and from these an estimate made of the rainfall. After comparing them with any existing rain gauge records which have been kept over a number of years in close proximity to the proposed site, the engineer should be able to strike a fair average of the rainfall. The longer the period taken, the better and more satisfactory average results will be obtained. From these records an estimate of the quantity available for storage can be calculated allowing, of course, for losses on the average rainfall due to evaporation, percolation, and absorption, which allowance can only be estimated from previous experience on similar gathering grounds, and practical experience of the engineer. After computing the available supply for storage, the available yield in gallons per day is arrived at. An excellent check on the amount—a really better method to obtain the actual supply—lies in the use of stream gauges. They should be placed, wherever possible, in the feed channel supplying the impounding dam, and, when fitted with an automatic recorder, render the operation a simple and accurate test for the actual yield.

In most cases part of this supply will have to be liberated to supply rivers, etc., for compensation water (usually fixed at ⅓) and this must be deducted before deciding upon the average available daily supply.

The size of the impounding dam should be next settled. The late Thomas Hawkesley's well-known formula, which gives the number of days' storage required, taking for safety the mean annual rainfall for the three driest years, is recommended. Then, after levelling and contouring the site, the engineer can determine the height and dimensions of the dam to impound the required number of gallons. The actual construction of the dam will depend largely on local conditions, especially as to material of which it will be constructed, but the ground should be carefully examined, trial holes sunk, plans prepared showing all levels, etc., and geological formation before the actual locality and line of the proposed structure can be definitely settled.

In this paper it is not proposed to enter into the actual design of the dam and the many calculations required as the subject cannot be treated properly in the limited space, but on its stability the engineer is very often confronted with serious difficulties, and the most important points for his careful consideration will be the foundations, stability of walls, and a properly designed overflow to take off the flood water. A dam may fail by overturning, crushing, sliding, shearing, or by rupture due to tension, and to safely guard against all these causes of failure the section of the wall must be such that the lines of resultant pressure, both when the dam is full or empty, must fall within the middle third of any horizontal joint, in order that the maximum pressure on the foundation will never exceed certain fixed limits of safety. The friction between any horizontal layers, into which the dam may be divided, and also between the main walls and their foundation must be sufficient to prevent any sliding taking place. The ideal and safe cross-section of wall is the one which is constructed of sufficient dimensions to safely withstand all these pressures. After they have been properly calculated, the method adopted by the author in calculating the required sections for the design of the walls is by mathematics, and on completing same, he re-checks graphically, so that the line of pressure must fall within the middle third.

A considerable economy can be made if the site of the valley across which it is proposed to construct the dam is narrow, by making the dam curved and reducing the section, but the author does not recommend, from a stability standpoint, a greater radius than 300 feet being actually constructed. One of the main points, frequently overlooked, and upon which the stability of the dam and safety of the system so largely depend, is the provision of a sufficiently large overflow to amply take care of all likely flood water, as without such the works may be seriously damaged and unnecessary trouble and expense incurred which, at little first cost, could easily be provided for. From the author's own observations and experience he advises a 3 to 4-ft. length of weir to every 100 acres of watershed, fixing the maximum height, in all cases, to which the water is allowed to rise above the crest of the weir at 1 ft. 6 in. to 2 ft.