FLOOD BARRIER SYSTEM

Background of Invention

In certain areas, homes, offices and commercial and factory buildings occasionally are inundated by flood waters. To minimize damage from rising flood waters, such structures can utilize temporary flood barriers that are installed in low level door and window openings, to seal those openings against inflow of water into the structure. Various barrier systems are available for this purpose, with a wide variety of design features dictated to some extent by the size of the opening to be protected.

For the protection of a relatively wide doorway, for example, against flood waters that may rise to a considerable level above the bottom of the door opening, the barrier system must have considerable structural soundness in order to effectively resist the pressure of water across a wide area and at a relatively high level. One such system that is effective for the purpose has been marketed by Presray Corporation, of Wassaic, New York and consists of a series of horizontally elongated barrier elements (sometimes referred to as "stop logs") which are assembled one atop the other, extending laterally across the full width of the door opening. The individual barrier elements are arranged so that one element is tightly sealed to each vertically adjacent element, and the individual barrier elements are clamped against the front face of the door opening, providing a full perimeter seal and a strong structure to hold back the rising waters.

As can be appreciated, for many locations, flooding is an infrequent event, perhaps an annual experience, or more likely, a situation that occurs only once every few years. Thus, it is typical and customary that the barrier systems are stored away during normal times, and installed only when there is an immediate threat of inundation. However, when

flooding circumstances arise, there is much work to do in order to seal all of the openings available in a typical structure, and speed and efficiency of installation can be extremely important because all of the low level openings must be sealed before the structure can be considered protected from inundation. In this respect, water flowing in through a single unprotected opening, even though others are protected, can inundate the entire structure and cause great damage.

The above referenced co-pending application of Jason W. Smith represents a substantial improvement in the ability to install stop log type flood barriers efficiently and quickly. The present invention seeks to provide still further improvements in such stop log barriers, to further facilitate rapid installation thereof. The barrier of the present invention also provides an advantageous interlocking feature to add strength to the structure and also to simplify and expedite installation and assembly.

Summary of the Invention

In the flood barrier of the invention, a plurality of individual stop log barrier elements are stacked one on top of the other, to a predetermined height suitable for the expected flood conditions. The individual barrier elements are clamped against a vertical sealing strip located at opposite sides of the opening to be protected, and each of the barrier elements is provided with a resilient sealing element along its bottom to form a seal with the underlying barrier element or, in the case of the bottom most element, with the threshold of the opening. The entire stack of barrier elements is subjected to downward pressure by vertically acting clamping elements at each side.

In accordance with one aspect of the invention, the individual barrier elements, which may be formed of extruded aluminum sections, are shaped such that each barrier element forms a novel mechanical interlock with the barrier element below. The arrangement allows an

upper barrier element to be initially engaged with the element below and then pivoted into an installed position in a simple and highly expeditious manner. This both facilitates the installation process and makes the assembly more stable and secure while the installation is under way.

Pursuant to another aspect of the invention, the new barrier structure incorporates an advantageous form of vertical rail member at each side of the opening to be protected. These rail members are formed with a pair of vertically extending channels, one to receive a vertically extending sealing element, and the other to receive a plurality of slideably positioned clamping assemblies. For each barrier element, a clamping assembly can be slid into a properly aligned position, engaged with a newly installed barrier element, and tightened against the barrier element to maintain it in sealing contact with the vertically extending sealing element. When a flood threat is over, the individual barrier elements are unclamped and removed to a storage location. In addition, the individual clamping assemblies can be removed by sliding them upward and out of the top of the channel that receives them, for storage along with the barrier elements. Thus, during periods when there is no flood threat, the only permanent installation remaining at the protected opening is the presence of the two vertical rail members which are rather unobtrusive and can be decorated or covered to blend with the basic building structure.

The barrier structure of the invention also advantageously incorporates a vertically acting clamping arrangement that is mounted above the uppermost barrier element, at each side thereof, arranged to bear downwardly on the entire stack of barrier elements to assure good sealing pressure between vertically adjacent elements. In the structure of the present invention, such vertically acting clamping mechanisms are slideably installed and removed from the same vertical channels that receive the clamping assemblies. This enables the clamping

arrangements to be quickly installed after the last barrier element is in place, and just as quickly removed and remotely stored when the flood threat has terminated.

For a more complete understanding of the above and other features and advantages of the invention, reference should be made to the following detailed description of a preferred embodiment, and to the accompanying drawings.

Description of the Drawings

Fig. 1 is a perspective view of a portion of a building or like structure having an opening in which the flood barrier structure of the invention has been installed.

Fig. 2 is a front elevational view of the barrier installation of Fig. 1.

Fig. 3 is a cross sectional view as taken generally on line 3-3 of Fig. 2.

Fig. 4 is an enlarged, fragmentary perspective view illustrating certain details of horizontal and vertical clamping arrangements incorporated in the structure of the invention.

Fig. 5A is an enlarged, fragmentary cross sectional view illustrating the manner in which an interlocking barrier element according to the invention is positioned for installation.

Fig. 5B is a view similar to Fig. 5A, showing the barrier element after being pivoted into installed position and engaged at the top by vertically acting clamping means.

Fig. 6 is an enlarged cross sectional view of a vertical rail element provided at each side of the opening to slideably position the various clamping elements incorporated into the structure.

Fig. 7 is an enlarged cross sectional view of a preferred form of sealing element utilized in the flood barrier of the invention.

Description of a Preferred Embodiment

Referring now to the drawings, the reference numeral 10 designates generally a building structure having a large door opening 11 therein which extends upward from a floor or threshold 12. A flood barrier assembly 13 (Figs. 1 and 3) constructed in accordance with the invention is shown as installed in the doorway 11 to provide a barrier against inundation by flood waters. The barrier is comprised of a plurality of individual, horizontally elongated barrier elements 14, stacked one on top of the other and extending across the full width of the door opening 11. As will become apparent, a flood barrier of any suitable height may be constructed, within the maximum capacity of the installation, by assembling a predetermined number of the barrier elements 14 in a vertical stack.

In the illustrated form of the invention, vertical rails 15, 16 are mounted on the front face of the building structure 10, at each side of the door opening 11. Typically, the rails 15 are permanently attached to the building structure and are bedded with suitable calking or other material to provide a watertight seal between the backs of the rails and the front surface of the building structure.

In the illustrated embodiment, the inside edges of the rails 15, 16 are provided with dovetailed channels 17 for reception of a resilient sealing element, such as illustrated at 18 in Fig. 7. The sealing element extends vertically over the full working height of each of the rails 15, 16

and provides a resilient surface against which back walls 19 of the barrier elements 14 can be pressed to form a continuous seal at the side edges of the structure. Bottom flange portions 20 of the barrier elements are provided with similar dovetailed channels 21 for receiving horizontally disposed sealing elements 18 extending across the full length of each of the barrier elements 14. As will be described in more detail, this provides for effective sealing between each of the barrier elements and its vertically adjacent neighboring barrier element to provide a highly effective, waterproof flood barrier for the door opening 11.

Pursuant to the invention, the individual barrier elements 14 can be extruded of a lightweight material, such as aluminum, with a uniform cross section throughout. The barrier elements are generally of a C-shaped cross section comprised of generally flat, vertical back wall portions 22 and forwardly extending upper and lower flange portions 23, 24. As a significant feature, the upper and lower flange portions 23, 24 are configured to provide a mutual mechanical interlock between vertically adjacent barrier elements, to both simplify assembly of a plurality of the barrier elements into a complete barrier structure, and to provide for a stronger and more stable structure during and after the assembly process. To this end, the upper flange portion 23 is comprised of a generally flat, forwardly extending back portion 25, a generally vertical riser 26, and a forwardly projecting upper flange portion 27. Preferably, the forward extremity of the upper flange portion 27 is rounded, as indicated at 28.

The bottom flange portion 24 of the barrier element is comprised of a relatively thick, downwardly extending extension 20, which includes the dovetailed slot 21 and mounts the sealing element 18. A forwardly extending base flange 29, extends forwardly from the extension 20 and terminates in a vertically downwardly extending flange 30. As shown in Figs. 5A and 5B, the inside corner between the lower flange elements 29, 30 is recessed with a concave, generally circular contour to form a socket

31, arranged to receive the rounded forward extremity 28 of the upper flange 27 of an adjacent, lower barrier element. The arrangement is such that, when building a barrier structure by assembling individual barrier elements 14 one on top of another, starting at the bottom, a new barrier element can be seated against a previously installed element in the manner shown in Fig. 5A, with the forwardly projecting flange edge 28 seated in the recessed socket 31 of the new element. The new element is thus properly aligned and supported on the previously installed element while in a forwardly tilted orientation, illustrated in Fig. 5A. When the new barrier element is thus seated, it can be pivoted rearwardly until the bottom surface of the flange 29 overlies the top surface of the flange 27. In this position, shown in Fig. 5B, the resilient sealing element 18 is compressed against the surface 25 of the adjacent lower barrier element, to form a tight seal between the two elements. The forward portions of the flanges 23, 24 are interlocked by engagement of the rounded outer end 28 with the concave socket 31, as shown in Fig. 5B, providing significant rigidity to the assembled structure.

In a related co-pending United States application Ser. No. 11/391110of Jason W. Smith, individual barrier elements are clamped at their respective opposite ends by clamping elements mounted on side rails, and the entire vertical stack of barrier elements is compressed downwardly by vertically acting clamping elements engaging the uppermost element. That same general arrangement is followed in the structure of the present invention, with certain significant improvements being provided to facilitate and expedite the installation of a flood barrier structure, which often must be done on an emergency basis, and also to facilitate the subsequent dismantling and removal of the structure after a flood threat subsides. To this end, each of the vertical side rails 15, 16 is provided with a vertical channel 32 partially closed by two front flanges 33, 34 (Fig. 6) to form a vertical slot 35. Clamping bolts 36, provided with square bases 37, are slideably but non-rotatably received in the vertical

channels 32. Each of the bolts 36 (with the exception of the uppermost one, to be later described) pivotally mounts a clamping bar 38 and a threaded tightening knob 39. The clamping bars 38 are freely pivotable on the bolts 36, and are of sufficient length that, when pivoted into a horizontal position, one end overlies a projecting flange 40 at the outer edge of each of the rails 15, 16, while the other end of the clamping bar overlies an end portion of an adjacent barrier element 14.

After each barrier element is initially positioned in the structure, a clamping assembly, comprising a bolt 36, clamping bar 38 and tightening knob 39 is inserted into the upper end of the rail channel 32 and slid downward to a position opposite the open end of the recently positioned barrier element. The clamping bar 38 is then pivoted from a vertical position to a horizontal position, with its inner end overlying the end of the barrier element 14, as generally shown in Fig. 2. The clamping bar can then be tightened by means of the knob 39 to press the barrier element against the vertical sealing element extending up the inside edge of the rails 15 or 16. During the initial assembly process, the clamping bars 38 are adjusted to press only lightly against the front of the barrier element, to securely hold it in assembled position, while accommodating subsequent limited downward movement when vertical compression is applied to the entire stack of barrier elements.

After the uppermost barrier element has been installed and lightly clamped, vertically acting clamping assemblies are installed in each of the side rails 15, 16. The vertically acting clamping assemblies, shown best in Fig. 4, comprise a support bar 41 formed along its back side with a contoured recess 42 shaped to fit closely with the configuration of the vertical rails 15, 16 and preferably to overlap the opposite side edges of the rails. A bolt assembly 43 has its base 36 inserted vertically into the rail channel 32 and slid downward to a position slightly above the uppermost barrier element 14. A bolt 44 extends through the support bar

41 and engages a tightening knob 45. This arrangement allows the clamping assembly to be moved to a suitable position above the uppermost barrier element, with the support bar 41 spaced a few inches above the surface 25 of the uppermost barrier element. The knob 45 is then tightened to secure the assembly in position.

At the inner end of the support bar 41 is a screw clamp 46 which threadedly engages the support bar 41 and has a clamping pad 47 at its lower end engaging the surface 25. When the clamping assembly is positioned as shown in Fig. 4, the threaded screw clamps 46 at each side are tightened, to press downwardly on the uppermost barrier element 14. This applies vertical clamping pressure throughout the entire stack of barrier elements, to assure good sealing between vertically adjacent elements. When vertically acting clamping pressure is applied by tightening of the elements 46, the support bar 41 is prevented from rotating by engagement of the side edges of the recesses 42 with their respective side rails 15, 16. This action also tends to lock the support bar 41 securely in its adjusted position.

After tightening of the vertically acting clamping elements 46, the various horizontal clamping bars 38 are tightened to press the individual barrier elements snugly against the sealing element 18 extending vertically up the front face of each of the rails 15, 16.

To advantage, the sealing elements 18 (Fig. 7) are formed of a high density neoprene closed cell sponge material 48, formed with an outer skin 49 and preferably with an elongated hollow portion 50. Along one side, the sealing element is formed with a deformable projection 51. The described form of sealing element, accommodates significant compression, so that highly effective sealing is assured. Additionally, the outer skin 49 provides resistance to scuffing, which is beneficial given that

the barrier elements may be installed, uninstalled and stored numerous times during their working life.

To particular advantage, the lower front flange portion 30 of the barrier element 14 projects downwardly to a level below the bottom surface 52 of the back lower flange portion 20, but above the lower surface 53 (Fig. 5A) of the sealing element 18 mounted in the flange portion 20, when the sealing element is in a relaxed state. This configuration allows the lowermost barrier element 14a (Fig. 3) to be placed directly on the threshold surface 54. With the flange portion 30 resting on the threshold surface 54, and the vertical back wall 22 of the barrier element positioned flat against the side rails 15, 16, the sealing element 18 of the lowermost barrier element 14a is tightly compressed against the threshold surface 54. With this arrangement, the lowermost barrier element 14 may in many cases be placed directly on the surface of a flat concrete threshold, avoiding the need for installing a special flat steel threshold, for example.

The flood barrier structure of the present invention has important advantages over known structures. Of particular importance, the interlocking configuration of the individual barrier logs not only expedites the assembly operations required to install a flood barrier, but enables the individual barrier elements to be of a lighter construction. As a result, the individual barrier elements are lighter in weight and easier to handle during installation and removal operations. Additionally, and importantly, the barrier elements are less costly, making the system more attractive in the marketplace.

The barrier structure of the invention significantly facilitates the installation of flood barriers of any desired height, to suit the expected flooding conditions. Moreover, should conditions be expected to worsen, after an initial installation of a partial height barrier, the barrier height may

be quickly increased by adding one or more barrier elements to the top of the existing stack. For both installation and removal of the structure, the clamping mechanisms, can be slid into or out of the vertical channels provided. When dismantling the barrier assembly, the clamping facilities are entirely removed from the side rails 15, 16, leaving only relatively plain, low profile side rails, free of projections and the like.

It should be understood, of course, that the specific forms of the invention herein illustrated and described are intended to be representative only, as certain changes may be made therein without departing from the clear teachings of the disclosure. Accordingly, reference should be made to the following appended claims in determining the full scope of the invention.

I Claim:

1. In a flood barrier system for sealing an opening (11) in a wall structure (10) against the inflow of flood waters and of the type which comprises

(a) a plurality of elongated barrier elements (14) of a length greater than a width of the opening (11),

(b) said barrier elements (14) having front and back sides and being oriented horizontally and stacked vertically one upon the other with their back sides (19) against an outer face of said wall structure to form a flood barrier (13),

(c) said barrier elements (14) being positioned with opposite end portions thereof overlapping outer surfaces of said wall structure (10) laterally adjacent opposite sides of said opening (11),

(d) a horizontal support surface (12) for a lowermost one (14a) of said barrier elements extending for the width of said opening,

(e) horizontally acting clamping elements (38) engaging the end portions of said barrier elements (14) for retaining back surface portions of said end portions in sealing relationship with said outer surfaces of said wall structure overlapped thereby, and

(f) vertically acting pressure clamps (41, 46) mounted on said wall structure and positioned above an uppermost one of said barrier elements to bear downwardly upon said uppermost barrier element and thereby upon the entire plurality of stacked barrier elements to provide a seal between vertically adjacent barrier elements (14) and between said lowermost barrier element (14a) and said support surface, the improvement characterized by

(g) said barrier elements (14) being formed with mutually interlocking top and bottom configurations whereby an upper portion of one barrier element is mechanically interlocked in a front-to-back direction with a lower portion of a second barrier element directly above and supported on said one barrier element,

(h) the bottom configuration of said barrier elements comprising front and back downwardly projecting portions (20, 30) and the top configuration of said barrier elements comprising an upwardly projecting portion (23) closely received between the downwardly projecting portions of a barrier element positioned immediately above.

2. A flood barrier system according to claim 1, wherein

(a) said downwardly projecting elements (20, 30) comprise a downwardly projecting front flange (30) at the front side of the barrier element, a downwardly projecting back flange (20) at the back side of the barrier element, and a support surface (29) extending between upper portions of said front and back flanges,

(b) the top configuration of said barrier elements comprises a support flange (27) positioned to underlie the support surface (29) of a barrier element positioned immediately above, a horizontally disposed sealing surface (25) extending rearwardly of said support flange and underlying the downwardly projecting back flange (20) of a barrier element positioned immediately above, and an upwardly extending portion (26) connecting a forward portion of said sealing surface (25) with a rearward portion of said support flange (27), and

(c) a resilient sealing element (18) is mounted at a bottom of said back flange (20) and positioned to establish pressure engagement between the sealing element of a first barrier element with the sealing surface (25) of a second barrier element positioned immediately below when said first barrier element is positioned over the support flange (27) of said second barrier element.

3. A flood barrier system according to claim 2, wherein

(a) said front flange (30) projects downwardly a distance greater than said back flange (20), and

said resilient sealing element (18) in an uncompressed configuration, projects downward below a bottom edge of said front flange (30).

4. A flood barrier system according to claim2, wherein

(a) said support flange (27) extends forwardly and is formed with a projecting forward edge (28),

(b) the bottom configuration of said barrier elements includes a socket (31) formed between the front flange (30) and support surface (29) for the reception of said projecting forward edge (28), whereby when two vertically adjacent barrier elements are assembled together, the forward portions of said barrier elements are vertically interlocked, and

(c) said vertically acting pressure clamps (41, 46) are positioned to act principally upon back portions of said barrier elements.

5. A flood barrier system according to claim 4, wherein

(a) said projecting forward edge (28) is formed with rounded convex contours, and

(b) said socket (31) is formed with rounded concave contours,

(c) whereby an upper barrier element (14) can be assembled with a lower barrier element by inserting the forward edge (28) of the lower element into the socket (31) of the upper element and pivoting the upper element about said forward edge until the sealing element (18) of the upper barrier element seats against the sealing surface (25) of the lower barrier element.

6. A flood barrier system according to claim 2, wherein

(a) said sealing element (18) of formed of a closed cell neoprene foam material,

(b) said downwardly projecting back flange (20) is formed in a central region thereof with a downwardly opening dovetail channel (21) extending along the length of the barrier element, and

(c) said sealing element (18) is formed with an upwardly projecting dovetail rib lockingly received in said dovetail channel.

7. A flood barrier system according to claim 1, wherein

(a) vertical rails (15, 16) are mounted in sealed relation to the front face of said wall structure (10) adjacent to side edges of the opening therein,

(b) said rails are formed with first and second vertical channels (17, 32) therein positioned adjacent inside and outside side edges respectively of said rails,

(c) vertical sealing strips (18) are received in said first vertical channels (17) and extending from bottom extremities of said rails to a level equal or higher than maximum height of a barrier system to be constructed,

(d) said second vertical channels (32) being formed with front flanges (33, 34) extending from opposite sides of the channels toward the centers thereof and defining a restricted channel opening,

(e) a plurality of bolt bases (37) slideably and non-rotatably received in said second vertical channels (32), each with a threaded bolt (36) extending forwardly through the restricted channel openings,

(f) said horizontally acting clamping elements include clamping bars (38) received on said bolts (36) and tightening nuts (39) received on said bolts in front of said clamping bars,

(g) said bolts (36) and bolt bases (37) being slideable vertically in said second vertical channels (32) to position the clamping bar (38) thereon opposite an end of a barrier element (14),

(h) said clamping bars (38) being rotatable on the bolts (36) such that the clamping bars may be pivoted into a position with one end bearing on a front-facing surface of a barrier element (14) and an opposite end bearing on a front-facing surface (40) of a vertical rail, whereby said barrier element may be forcibly compressed against the sealing element (18) in said rail.

8. A flood barrier system according to claim 7, wherein

(a) said barrier elements (14) are of a generally C-shaped configuration comprising upper and lower portions (23, 24) and a vertical portion (22) joining said upper and lower portions, and

(b) said vertical portion (22) has a flat back surface engageable with the vertical sealing elements (18) on said vertical rails (15, 16) and a front surface engageable at opposite ends by said clamping bars (38).

9. A flood barrier system according to claim 7, wherein

(a) a pair of uppermost clamping bars (41) are positioned on bolts (44) and bolt bases in uppermost portions of said second vertical channels (32),

(b) said uppermost clamping bars (41) cooperate with said vertical rails (15, 16) to restrain rotation of said uppermost clamping bars (44) about the bolts (44) on which they are positioned,

(c) inner portions of said uppermost clamping bars (44) extend over the tops of an uppermost one of said barrier elements (14), and

(d) each of said uppermost clamping bars (41) includes a vertically acting pressure clamp (46, 47) adjustable to bear downward on said uppermost barrier element to apply vertical pressure to a stack of barrier elements forming a flood barrier.

10. A flood barrier system according to claim 9, wherein,

(a) said uppermost clamping bars (41), along with the bolts (44) and bolt bases on which they are positioned, are vertically movable in said second vertical channels (32) to positions closely overlying the uppermost barrier element in a stack thereof, and

(b) said uppermost clamping bars (41) are at least partially self-locking in any vertically adjusted positions on said vertical rails upon the application of vertically acting pressure to said uppermost barrier element.

11. A flood barrier system for sealing an opening (11) in a wall structure (10) against the inflow of flood waters, which comprises

(a) a plurality of elongated barrier elements (14) of extruded, generally C-shaped cross section,

(b) each of said barrier elements (14) comprising, in cross section, a bottom flange structure(24), a top flange structure (23), and a generally flat back wall structure (22) extending between said top and bottom flange structures,

(c) said bottom flange structure (24) comprising spaced apart, downwardly extending front and back flange (30, 20) portions and a connecting flange portion (29) extending between upper portions of said front and back flange portions,

(d) said top flange structure (23) comprising a first, generally horizontal flange portion (25) extending forwardly from said back wall structure (22), a second flange portion (26) extending upwardly from a forward edge of said first flange portion, and a third flange portion (27) extending forwardly from an upper edge of said second flange portion (26),

(e) said second and third flange portions (26, 25) of said top flange structure (23) being interlockingly engageable with the bottom flange structure (24) of another barrier element positioned directly above, and

(f) a resilient sealing element (18) carried by one of said top or bottom flange structures to effect sealing engagement with another barrier element positioned directly above or below.

12. A flood barrier system according to claim 11, wherein

(a) the front flange portion (30) of said bottom flange structure (24) has a bottom edge positioned below a bottom surface of the back flange portion (20) of said bottom flange structure,

(b) said resilient sealing element (18) is mounted on the bottom surface of said back flange portion (20),

(c) said resilient sealing element, in an uncompressed condition thereof, having a bottom surface portion (53) positioned below the bottom edge of said front flange portion (30).

13. A flood barrier system according to claim 12, wherein

(a) said wall structure opening (11) is defined in part by a threshold surface (12),

(b) a lowermost one of said barrier elements (14a) is supported on said threshold surface with said back wall structure (22) extending substantially vertically, said front flange portion (30) resting on said threshold (12) and said sealing element (18) being supported on said threshold in a partially compressed condition to form a seal with said threshold.

14. A flood barrier system according to claim 12, wherein

(a) the front and connecting flange portions (30, 29) of said bottom flange structure define a longitudinally extending socket structure (31) in a region at which said flange portions are joined,

(b) the third flange portion (27) of said top flange structure (23) having a forward edge portion (28) receivable in the socket structure (31) of the bottom flange structure (24) of a barrier element positioned directly above for interlockingly joining a first barrier element with a second barrier element positioned directly above the first barrier element.

15. A flood barrier system according to claim 14, wherein

(a) the forward edge (28) of said top flange structure (23) and said socket structure (31) being formed with complimentary curved contours whereby said second barrier element can be engaged with and pivoted with respect to said first barrier element.